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ABSTRACT

This course of study in automotive body and fender repair is intended as a teaching and learning guide. The guide includes the following information and materials: the course philosophy, general course objectives, a plan of instructional practices, a list of curriculum materials, the course outline, and written instructional aids. The course outline contains an occupational description, a list of the major divisions of the occupation, a list of the skill competencies/operations that are required of the students, and a list of the information lessons which correspond to the skill competencies. The instructional aids comprise a major portion of the document and include the following materials: job sheets which indicate to the student what to do in performing the various jobs assigned by the instructor; operation sheets which supplement the job sheets and indicate how to perform the particular skill competencies necessary to complete the assigned job; information sheets which also supplement the job sheets and provide the information necessary for completing the assigned job with the highest possible degree of understanding; and assignment sheets which supplement the job sheets by providing mental activities or exercises related to the assigned job. The appendix contains lists of tools and equipment needed to teach the course. (EM)

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TRADE AND INDUSTRIAL EDUCATION

COURSE OF STUDY

FOR

AUTOMOTIVE BODY AND FENDER

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IN COOPERATION WITH

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Harrisburg, Pennsylvania

1977

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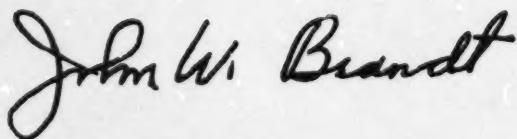
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PREFACE

In recent years, we have planned and constructed the finest of vocational education facilities and have placed fine equipment in these facilities. Equal attention must be directed to provide the teacher with the basic tools for instruction to assist in providing quality instruction.

This basic course of study is intended to be used as a teaching and learning guide. The information provides the essentials of the occupation, insuring that the students who successfully complete the course will have sufficient competencies for initial employment and ample orientation for growth and advancement. The teacher who uses this course may find it necessary to modify and supplement the material to meet the needs of specific students and the local industrial community.

This material has been prepared by a committee of teachers under the general direction of the staff of the Division of Occupational and Vocational Studies at the Pennsylvania State University in cooperation with the Trade and Industrial Education staff of the Bureau of Vocational Education.



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1977

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COURSE PHILOSOPHY

The primary function of this course in Automotive Body and Fender is to develop the individual into a productive, knowledgeable citizen, who is capable of providing for himself and his charges in a manner that is beneficial to himself and the community in which he lives.

The student who completes the Automotive Body and Fender course will be better prepared to pursue a livelihood in this field as he will have been exposed to the latest training techniques and related information. The instructions provided should develop the skills and knowledge of the trade in the student to his fullest potential so that he can enter employment in the trade as a knowledgeable apprentice.

Differences in students' abilities can be provided for through levels of work assignment.

GENERAL COURSE OBJECTIVES

Objectives

1. To develop specific skill competence and related knowledge associated with the occupation of automotive body and fender repairmen.
2. To develop an understanding of labor and management.
3. To develop good habits of work.
4. To develop occupational safety habits and understandings.
5. To develop ability to work co-operatively with fellow workers.

Activities to Achieve Objectives

1. Series of individual jobs.
 2. Several practice exercises.
 3. Series of group jobs.
 4. Provide job sheets, operation sheets, information sheets and assignment sheets for individual student use.
-
1. Assign reading in several trade magazines.
 2. Arrange for talks by men in industry representing both labor and management.
 3. Schedule discussion on problems dealing with:
 - a. Labor Unions
 - b. Responsibilities of Management
 - c. Provide suggestion box for ideas on running a shop
-
1. Provide specific standards for each work job.
 2. Provide a clean, well-organized practice area and classroom that are conducive to effective learning.
 3. Discuss with students the importance of good work habits in relation to industrial practice, job advancement, etc.
 4. Measure student's work objectively.
 5. Provide a means for students to plan their work accurately and methodically.
-
1. Display safety posters
 2. Provide safety devices for all hazardous work jobs.
 3. Demonstrate correct safety practices whenever appropriate.
 4. Show movie on safety.
-
1. Set up a maximum of class and group projects.
 2. Encourage students to seek help from each other.
 3. Provide student planning committee.
 4. Assign more advanced students to assist students needing help.

6. To stimulate the development of leadership qualities.

1. Provide opportunity for students to plan their assigned work jobs and write their own job sheets.
2. Provide a plan for students to appraise their own work.

PLAN OF INSTRUCTIONAL PRACTICE

The effectiveness of instruction depends on the careful organization and control of the routine details concerning the management of the pupil, equipment, teaching methods and the physical laboratory arrangement. The teacher must determine the best management practices and formulate a very definite statement of the basic standards to be followed in teaching the course to bring about the attainment of the learning goals.

Length of Course

The course of study is designed as a three-year curriculum involving approximately 1500 hours of class and laboratory instruction, primarily for beginning students who are interested in securing employment in the occupation. Where job entry is the goal, the entire course of study would be appropriate. In adults programs, it may be found that a single thrust is the student's goal, therefore, the course content may be restricted to a single major division.

Use of This Course of Study

The material has been arranged in major divisions of the trade. In most cases, the material contained in the first division must be learned before progressing to the next division. The nature of some trade areas permit entry into random divisions after the introductory basic material is covered. Some divisions of the occupation can be taught separately.

The content of this course material consists of job sheets (yellow) and skill competency sheets (white). The skill competency sheets are simply written and highly illustrated. These sheets outline the manipulative handling of tools and materials that make up the doing part of the occupation. The sequence of the skill competency sheets (SC) is based on the organization of the job sheets. Notice that job number one incorporates the basic skill competencies and job number two includes additional skill competencies. This cumulative reuse of the skill competencies continues throughout the entire job sheet collection. After a number of jobs have insured that the student has been sufficiently exposed to a skill competency, no further reference to that skill competency is made.

The job sheets are arranged in an order that gradually exposes the skill competencies. The purpose of the job sheet is to insure the introduction of each operation or skill competency in a controlled manner. Look at this group of jobs as a framework that can be added to, by you, to meet local needs. You may decide to design new or different jobs that will be inserted between or replace any of the suggested jobs. In time you will be able to custom design a course of study for your own needs. There will be little or no need to vary the skill competency sheets.

Teaching Methods

The following procedures are offered as the most productive in achieving the desired results in this course.

1. Demonstrations--Operations and procedures will be demonstrated while the students observe. The purpose is to show how things are done correctly and safely.
2. Class Discussion--A method of teaching in which the students and the teacher take part, directed and controlled by the teacher to a predetermined objective. Technical and related information common to a class or group of students will be presented in this manner. Evaluation of the material presented in this manner should be done by objective testing.
3. Laboratory Talks--Short, informal talks by the instructor during laboratory activities to convey information pertinent to the activity in progress. Not scheduled and not timed, this activity should occur at any appropriate time and for periods of varying duration.
4. Observation and Input--This teacher activity should take place at all times when students are performing psychomotor skills. The purpose is to reinforce a previously given demonstration, class discussion, or laboratory talk, or to update the students' skills by further demonstration and/or further disclosures of technical and related information.

Vehicles of Instruction

The application phase of this course will consist of work assignments kept as close to industrial conditions as a shop situation permits. Job, operation and information sheets will be provided, so that students of different levels of skill and ability can understand them. The students will be encouraged to progress as rapidly as possible, and achieve the standard set for the course. Special attention will be given to the unique student, offering special assistance so that slow as well as fast students may progress at their own rate of speed.

Average Size of Class

This course is designed for a class of not more than twenty students.

Physical Facilities Required

An instruction planning center with an area of 425 square feet will be required for class discussion, shop talks and some demonstrations. In addition an adjacent shop area of 3,000 - 3,400 square feet is needed. This shop needs to be designed to include the following work areas.

1. Welding - gas and electric
2. Metal work - beginners and advanced
3. Frame work
4. Painting
5. Glass work

6. Trim work - actual sewing (optional dependent on local needs)
7. Electricity
8. Radiator repair (optional)
9. Hydraulic - vacuum and air
10. Air Conditioning - If the school has an air conditioning course in its program of instruction, delete this section from the automotive body and fender course.

Items to be Developed by Local Teacher

The following items are peculiar to the local school situation and need to be developed by each local instructor.

- . Standards of attainment required
- . Pupil work evaluation
- . Shop controls and regulations
- . Pupil personnel organization
- . Method of tool check
- . Records and forms

CURRICULUM MATERIALS FOR
AUTOMOTIVE BODY & FENDER

List Material - Date, Pages,
Price, etc.

Available From

AUTOMOTIVE BODY & FENDER REPAIR
1967, 67 PAGES, \$1.50 (offset)

Instructional Materials Laboratory,
Ohio State University, 1885 Neil
Avenue, Columbus, Ohio 43210

AUTOMOTIVE BODY REPAIR
Workbook, Rev. 1965, 156 pages
(offset) 10 units, 52 instructional topics.
Testbook, Rev. 1965, \$2.25
(offset) Examination, Rev.
1965, \$0.35 (offset)

California State Department of Ed.,
Fiscal Office--Order Section
721 Capitol Mall, Sacramento,
California 95814

AUTOMOTIVE BODY & FENDER REPAIR
Study Guide, 1966, 90 pages
\$1.00 (mimeo) 72 assignments.
Answer Book, 1966, 58 pages,
\$1.00 (mimeo), Job Tests,
1966, 67 pages, \$1.00 (mimeo)
Job Test Answers, 1966, 17
pages, \$0.75 (mimeo)

Instructional Materials Unit, Voc.
Industrial Education Department,
P.O. Box 2847, University, Alabama
35486

VOCATIONAL AUTOMOBILE BODY REPAIR-
BASIC PLAN FOR THE ORGANIZATION
& MANAGEMENT OF INSTRUCTION
Instructor's Guide, 1967,
25 pages, \$1.00 (offset)

Curriculum Materials Laboratory,
Department of Industrial Education,
Mississippi State University
Box NU, State College, Mississippi
39762

AUTOMOTIVE BODY REPAIR
Study Guide, 1967, 166 pages,
\$1.50 (mimeo), 21 assignments
Instructor's key, 1967,
22 pages, \$0.50 (mimeo)

Instructional Materials Center
Department of Industrial Education,
University of Missouri, Columbia,
Missouri 65201

BASIC AUTOMOTIVE REPAIR - I
Student Manual, 1965, 152
pages, \$2.00 (offset)

Curriculum Laboratory, Department
of Vocational-Technical Education,
Graduate School of Education, Rutgers-
The State University, 10 Seminary
Place, New Brunswick, New Jersey
08903

AUTOMOTIVE BODY & FENDER REPAIR
Study Guide and Unit Tests
1967, \$3.75 (offset), 23 units,
60 assignments.
Answer Book, 1967, \$1.90
(offset)

Instructional Materials Production,
Engineering Extension Service, College
of Engineering, Texas A&M University,
Box 236 FE, College Station, Texas
77843

List Material - Date, Pages,
Price, etc.

AUTO BODY REPAIR & PAINTING
Basic Course Outline, Rev. 1964,
53 pages, \$1.25 (offset)

AUTOMOTIVE BODY REPAIR
Instructor's Guide, 1964,
30 pages, \$1.25 (mimeo)

Available From

Instructional Materials Production
Engineering Extension Service,
College of Engineering, Texas A&M
University, Box 236 FE, College
Station, Texas 77843

State Supervisor, Department of Voc.
Education, Capitol Building,
Charleston, West Virginia 25305

COURSE OUTLINE

Instructional Title: Automotive Body and Fender

Code: 17.0301

Occupation Description

Repairs damaged bodies and body parts of automotive vehicles, such as automobiles and light trucks: examines damaged vehicles and estimates cost of repairs. Removes, repairs and replaces upholstery, accessories, electrical and hydraulic window-and-seat-operating equipment, and trim to gain access to vehicle body and fenders. Remove and replace glass. Places dolly block against surface of dented area and beats opposite surface with hammer to remove dents. Fills depressions with solder or other plastic material. Removes excessively damaged fenders, panels and grills, using wrenches and cutting torch, and attaches replacements by bolting or welding them in position. Straightens bent frames, using hydraulic jack and pulling device. Files, grinds, and sands repaired surfaces, using power tools and handtools. Re-finishes repaired surfaces by painting with primer coat and sanding it smooth. Aims headlights, aligns and balances wheels, repairs and replaces brake system, air conditioning and radiators. May paint surfaces after performing body repairs and be designated AUTOMOBILE-BODY REPAIRMAN, COMBINATION.

Related Areas of Employment

Automobile-body worker; automobile-collision serviceman; body-and-fender repairman; body-line finisher; body man; bumper; dent remover; dingman; fender-and-body repairman; hammer-out man; metal bumper; metal shrinker; metal worker; touch-up finisher, metal; radiator repairman; automotive glass installer; frame repairman, front end aligner; trim man.

Major Divisions of the Occupation

I. Metal Work

- A. Oxyacetylene Welding
- B. Electric Welding
- C. Fill Deformed Areas
- D. Repair Damage
- E. Replace Parts or Sections
- F. Trim Work
- G. Glass Work

II. Spray Painting

III. Electricity

IV. Frame Work

V. Hydraulics

VI. Air Conditioning

VII. Radiator Repair

Skill Competency Development Jobs

The following is a list of jobs, assigned by the teacher, to provide experience for the student to help develop his competency in the Upholstery trade. These are job titles only. The numbers correspond with the identifying numbers of the job sheets that follow:

UNIT I. METAL WORK

A. Oxyacetylene Welding (First Year)

- J-1A-1 Weld a 6" Double Flange Weld
- J-1A-2 Weld a 6" Butt Weld
- J-1A-3 Weld a 6" Lap Weld
- J-1A-4 Weld a 6" Double Fillet Weld
- J-1A-5 Weld a 6" Multi-Bead Weld
- J-1A-6 Braze a 6" Butt Joint
- J-1A-7 Braze a 6" Lap Joint
- J-1A-8 Braze a 6" Fillet Section
- J-1A-9 Cut Sheet Metal Car Panel with Oxy-acetylene Cutting Torch
- J-1A-10 Cut In 1/8" Steel Plate with Oxy-acetylene Torch, Six Inch
- J-1A-11 Cut 3/8" Steel Plate with Oxy-acetylene Torch, Six Inch
- J-1A-12 Cut Rivets and Bolts From Frame
- J-1A-13 Weld a 6" Cut in a Fender
- J-1A-14 Braze a 6" Square Patch Panel

B. Electric Welding (Second Year)

- J-1B-1 Electric Weld Short Beads
- J-1B-2 Electric Weld a Butt Weld
- J-1B-3 Electric Weld a Fillet Weld
- J-1B-4 Electric Weld a Lap Weld
- J-1B-5 Spot Weld

C. Fill Deformed Areas (First Year)

- J-1C-1 Solder a 6" Butt Welded Seam
- J-1C-2 Solder a 9" Square Dent in Hood or Trunk Lid

- J-1C-3 Solder a 9" Square Dent in a Door
- J-1C-4 Solder a 9" Square Dent on the Door Opening
- J-1C-5 Fill a 9" Square Dent in Hood or Trunk with Plastic
- J-1C-6 Fill a 9" Square Dent in Door with Plastic
- J-1C-7 Fill a 9" Square Dent in a Rocker Panel with Plastic
- J-1C-8 Repair Fiberglass - Large or Small Hole
- J-1C-9 Repair Fiberglass - Broken or Shattered Area

D. Repair Damage (First Year)

- J-1D-1 Repair a 100 Square Inch Dent in a Front Fender
- J-1D-2 Repair a 100 Square Inch Dent in a Door
- J-1D-3 Repair a 100 Square Inch Dent in a Trunk Lid
- J-1D-4 Repair a 100 Square Inch Dent in a Hood
- J-1D-5 Repair the Crushed Headlight Area of a Front Fender
- J-1D-6 Repair a Front Fender Using the Stretch Method

(Second Year)

- J-1D-7 Repair and Refinish Front Door
- J-1D-8 Repair and Refinish Rear Door
- J-1D-9 Repair and Refinish a Door Post
- J-1D-10 Repair and Refinish a Rocker Panel
- J-1D-11 Repair and Refinish a Front Fender by Using a Patch Panel
- J-1D-12 Repanel and Refinish a Door
- J-1D-13 Repair and Refinish a Quarter Panel
- J-1D-14 Repair and Refinish a Quarter Panel by Using a Patch Panel
- J-1D-15 Repair and Refinish a Trunk Lid
- J-1D-16 Repair and Refinish a Lower Trunk Panel
- J-1D-17 Repair and Refinish a Roof
- J-1D-18 Repair and Refinish a Cowl
- J-1D-19 Repair and Refinish a Dash Panel
- J-1D-20 Repair and Refinish a Dog Leg

E. Replace Parts or Sections (Third Year)

- J-1E-1 Replace and Align a Front Bumper
- J-1E-2 Replace and Align New Gravel Deflector
- J-1E-3 Replace and Align a New Grille
- J-1E-4 Replace and Align a New Headlamp Assembly
- J-1E-5 Replace and Align New Radiator Support
- J-1E-6 Replace and Align Radiator
- J-1E-7 Replace and Align Front Fender
- J-1E-8 Replace and Align Hood
- J-1E-9 Replace and Align Front Door
- J-1E-10 Replace and Align Center Door Post
- J-1E-11 Replace and Align Rear Door
- J-1E-12 Replace and Align Rocker Panel
- J-1E-13 Replace and Align Quarter Panel
- J-1E-14 Replace and Align Rear Bumper
- J-1E-15 Replace and Align Trunk Lid
- J-1E-16 Replace and Align Roof Panel
- J-1E-17 Replace and Align Dash Panel
- J-1E-18 Replace and Align Wheel Well
- J-1E-19 Replace and Align Floor of the Trunk Compartment
- J-1E-20 Replace and Align Tailgate on Station Wagon
- J-1E-21 Replace and Align Dog Leg

F. Trim Work (Second Year)

- J-1F-1 Remove and Replace Kick Pads
- J-1F-2 Remove and Replace Door Panels
- J-1F-3 Remove and Replace Headliner
- J-1F-4 Disassemble and Rebuild Seats
- J-1F-5 Sew Torn Seat Cover
- J-1F-6 Fabricate Seat Cover Insert

- J-1F-7 Remove and Replace Floor Mats
- J-1F-8 Lay Out, Sew and Install New Headliner
- J-1F-9 Remove and Install Trunk Trim
- J-1F-10 Replace Dash Padding
- J-1F-11 Remove and Replace Door Post Trim

G. Glass Work (Third Year)

- J-1G-1 Remove and Replace Front Door Glass
- J-1G-2 Remove and Replace Front Door Vent Glass
- J-1G-3 Remove and Replace Rear Door Glass
- J-1G-4 Remove and Replace Rear Quarter Glass
- J-1G-5 Remove and Replace Quarter Window Glass in Station Wagon
- J-1G-6 Remove and Replace Windshield Glass
- J-1G-7 Remove and Replace a Rear Window in Sedan
- J-1G-8 Remove and Replace Rear Window Glass in Station Wagon

UNIT II. SPRAY PAINTING

(First Year)

- J-2-1 Prepare, Paint and Finish a Panel
- J-2-2 Prepare and Spot-Paint a Panel
- J-2-3 Prepare and Paint a Panel
- J-2-4 Clean Car Interior
- J-2-5 Wash a Car
- J-2-6 Polish and Wax a Car
- J-2-7 Recondition a Used Car
- J-2-8 Recondition Vinyl and Top Materials

(Second Year)

- J-2-9 Refinish Vehicle in Enamel
- J-2-10 Refinish Vehicle in Lacquer
- J-2-11 Spray Imitation Vinyl Top

- J-2-12 Dye Convertible Top
- J-2-13 Refinish Interior (Spray)
- J-2-14 Refinish Wheels
- J-2-15 Stripe Body as Required by Hand
- J-2-16 Stripe Body with Decals
- J-2-17 Stripe Bddy as Required by Spray (Special tape for masking)

UNIT III. ELECTRICITY

(Second Year)

- J-3-1 Remove and Replace Battery
- J-3-2 Remove and Replace a Generator
- J-3-3 Remove and Replace an Alternator

UNIT IV. FRAME WORK

- J-4-1 Repair Frame, Sidesway, Sag and Mash Unitized Body Front and Rear
- J-4-2 Repair Frame Cross Member Sag
- J-4-3 Repair Frame Horn, Sidesway, Sag and Mash Regular Frame Front
- H-4-4 Repair Frame Sidesway, Sag and Mash Regular Frame (Rear)
- J-4-5 Repair Frame Twist Damage
- J-4-6 Repair Frame Diamond Damage
- J-4-7 Align Front End

UNIT V. HYDRAULICS - VACUUM AND AIR

(Second Year)

- J-5-1 Replace a Master Cylinder
- J-5-2 Reline Disc Brakes Hydraulic System
- J-5-3 Reline Drum Brakes Hydraulic System
- J-5-4 Rebuild Wheel Cylinder
- J-5-5 Replace Rubber or Steel Brake Line

UNIT VI. AIR CONDITIONING

(Third Year)

Job sheets to be developed on a basis of equipment available.

UNIT VII. RADIATOR REPAIR

(Third Year)

- J-7-1 Repair Radiator Neck Opening
- J-7-2 Repair Radiator Tubes
- J-7-3 Repair Radiator Core
- J-7-4 Replace Radiator Core
- J-7-5 Remove and Replace Radiator Tanks

Skill Competencies and Information Lessons

The left hand column lists the tasks or operations workers perform in the occupation which form the skill competencies required of the student. These competencies should be demonstrated by the teacher and practiced by the student.

The information lessons outline the general technical information and knowledge needed to perform the skill competencies. These items represent the common information taught on a group instruction basis. Additional information will emerge to be taught on an individual student basis as pupils work on the skill competencies.

The numbers preceding each title correspond to the identifying numbers of the operation sheets and the information sheets. The information lessons relate to the particular major unit of instruction but do not necessarily relate to corresponding skill competency numbers.

Unit I. Metal Work

Skill Competencies/Operations The student will be able to:		Information Lessons	
A. Oxyacetylene Welding		A. Oxyacetylene Welding	
SC-1A-1	Cut with Tin Shears	IL-1A-1	General First-Aid Practices
SC-1A-2	Set Up Welding Equipment	IL-1A-2	Safety Relating to Oxy-acetylene Welding
SC-1A-3	Clean Welding and Cutting Tips	IL-1A-3	How to Select and Use Fire Extinguishers
SC-1A-4	Light and Shutdown Welding Torch	IL-1A-4	Oxygen and Acetylene Gas
SC-1A-5	Weld Without Filler Rod	IL-1A-5	Cylinder Size and Construction
SC-1A-6	Weld With Filler Rod	IL-1A-6	Types of Oxy-acetylene Torches
SC-1A-7	Weld with Filler Rod in a Horizontal Position	IL-1A-7	Welding Flames and Their Uses
SC-1A-8	Weld with Filler Rod in a Vertical Position	IL-1A-8	Welding Equipment and Material Costs
SC-1A-9	Braze Weld	IL-1A-9	Regulator Function and Construction
SC-1A-10	Set Up and Adjust Cutting Equipment	IL-1A-10	Welding Protective Devices and Dress
SC-1A-11	Cut Sheet Metal	IL-1A-11	Types and Sizes of Welding and Spelter Rods
SC-1A-12	Cut 1/4" and Thicker Plate Metal	IL-1A-12	Types and Uses of Welding and Brazing Fluxes

Skill Competencies/Operations The student will be able to:		Information Lessons	
B. Electric Welding		B. Electric Welding	
SC-1B-1	Strike an Arc and Run a Bead	IL-1B-1	Arc Welding Safety
SC-1B-2	Spot Weld	IL-1B-2	Welding Machines
		IL-1B-3	General Information on Arc Welding
		IL-1B-4	Electrodes
		IL-1B-5	Spot Welding
C. Fill Deformed Areas		C. Fill Deformed Areas	
SC-1C-1	Grind with a Portable Electric Disc Grinder	IL-1C-1	Safety Relating to Filling
SC-1C-2	Trim the Grinding Disc	IL-1C-2	Methods of Cleaning for Soldering
SC-1C-3	Prepare Metal Surface for Tinning	IL-1C-3	Types of Tinning Materials
SC-1C-4	Tin Metal for Solder	IL-1C-4	Soldering Paddles - Sizes and Uses
SC-1C-5	Solder Horizontally	IL-1C-5	Soldering Paddle Lubricants
SC-1C-6	File and Sand Solder to Contour	IL-1C-6	Types and Grades of Solder
SC-1C-7	Solder Vertically	IL-1C-7	Plastic Fillers
SC-1C-8	Solder Overhead	IL-1C-8	Abrasives
SC-1C-9	Fill with Plastic Filler	IL-1C-9	Grinding
SC-1C-10	Prepare and Apply Fiberglass	IL-1C-10	Prevent Skin Irritation
		IL-1C-11	Fiberglass
D. Repair Damage		D. Repair Damage	
SC-1D-1	Use a Dolly and Hammers	IL-1D-1	Safety Relating to Metal Work
SC-1D-2	Shrink Sheet Metal	IL-1D-2	Types of Dollies
SC-1D-3	Use Pick Bars	IL-1D-3	Types and Uses of Metal Hammers and Slappers
SC-1D-4	Use a Caulking Iron	IL-1D-4	Identification of Spoons, Caulking and Bending Irons
SC-1D-5	Use Body Spoons		

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-1D-6	Use Hand and Power Panel Cutters	IL-1D-5	Molecular Structure of Metals
SC-1D-7	Slap Sheet Metal	IL-1D-6	Basic Steps in Metal Repair
SC-1D-8	Repair a Concave Surface	IL-1D-7	Repair Methods
SC-1D-9	Repair a Convex Surface	IL-1D-8	Metal Bumping
SC-1D-10	Repair an Oil Can Effect	IL-1D-9	Metal Reactions to Heat
SC-1D-11	Use Suction Cups	IL-1D-10	Use and Care of Slide Hammer and Pullrods
SC-1D-12	Use Slide Hammers	IL-1D-11	Use and Care of Flanging and Beading Tools
SC-1D-13	Apply Tension Plates	IL-1D-12	Identification and Use of Suction Cups
SC-1D-14	Use Adapters and Heads for Porto-Powers	IL-1D-13	Porta-Powers
SC-1D-15	Use Porto-Powers	IL-1D-14	Metal Cutters
SC-1D-16	Use Pull Rods	IL-1D-15	Taps, Dies, and Screw Extractors
		IL-1D-16	Body Files
		IL-1D-17	Estimating
E. Replace Parts or Sections		E. Replace Parts or Sections	
SC-1E-1	Remove and Replace Defective Nuts and Bolts	IL-1E-1	Safe Use of Tools
		IL-1E-2	Types, Uses and Care of Screwdrivers
		IL-1E-3	Safe Operation of the Grinder
		IL-1E-4	Types, Uses and Care of Wrenches
		IL-1E-5	Ratchet and Socket Use and Care
F. Trim Work		F. Trim Work	
SC-1F-1	Use the Hog Ring Pliers	IL-1F-1	Glossary of Upholstery Terms
SC-1F-2	Replace Seat Springs	IL-1F-2	Upholstery Materials
SC-1F-3	Replace Bobbin	IL-1F-3	Needles

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-1F-4	Wind the Bobbin	IL-1F-4	Tools and Equipment for Upholstery
SC-1F-5	Thread the Sewing Machine Needle and Adjust Stitch Length	IL-1F-5	Seat Springs
SC-1F-6	Sew with Sewing Machine		
G. Glass Work		G. Glass Work	
SC-1G-1	Remove Reveal Molding	IL-1G-1	Automotive Glass
SC-1G-2	Remove Glass with Hot Knife	IL-1G-2	Door and Glass Service
SC-1G-3	Use Caulking Gun to Apply Adhesive	IL-1G-3	Windshields, Rear Windows and Quarter Glass Station

Unit II. Spray Painting

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-2-1	Clean a Surface Prior to Sanding	IL-2-1	Safety Related to Paint and Spraying
SC-2-2	Feather Edge and Sand a Panel	IL-2-2	Paint Surface Preparation Equipment
SC-2-3	Apply Masking Tape	IL-2-3	The Spray Gun
SC-2-4	Deoxidize Sheet Metal	IL-2-4	Spray Gun Operating Principles and Adjustments
SC-2-5	Mix Primer-Surfacer	IL-2-5	Cleaning the Spray Gun and Maintenance
SC-2-6	Adjust and Use Spray Gun	IL-2-6	Using the Spray Gun
SC-2-7	Mix and Strain a Color Coat Paint	IL-2-7	Air Compressors and Regulators
SC-2-8	Spray Lacquer	IL-2-8	Spray Booth and Respirators
SC-2-9	Clean a Spray Gun	IL-2-9	Masking Paper and Tape
SC-2-10	Spray Enamels	IL-2-10	Types and Selection of Thinner and Reducers
SC-2-11	Degrease an Engine	IL-2-11	Types of Primers
SC-2-12	Clean Upholstery with a Brush	IL-2-12	Types of Finish Paints
SC-2-13	Stripe Body as Required by Hand	IL-2-13	Types and Uses of Solvents and Cleaners
SC-2-14	Apply Strip Decal Transfers	IL-2-14	Types and Uses of Sealers
SC-2-15	Stripe Body Using Special Tape for Masking as Required	IL-2-15	Types and Uses of Rubbing Compounds
		IL-2-16	Purposes and Uses of Paint Strainers
		IL-2-17	Types and Uses of Putty
		IL-2-18	Types, Purposes, Uses and Storage of Reducers and Thinners
		IL-2-19	Principles of Color Matching
		IL-2-20	Purposes and Uses of Sanding Blocks and Squeegee

Skill Competencies/Operations The student will be able to:	Information Lessons
IL-2-21	Grits, Sizes, Types and Purpose of Sandpaper
IL-2-22	Fish-Eye Elimination and Anti-Wrinkle Agents
IL-2-23	Glossary of Refinishing Terms
IL-2-24	Stripes and Decals
IL-2-25	Spray-On Immitation Vinyl Top

Unit III. Electricity

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-3-1	Activate Dry Charge Battery	IL-3-1	Relays and Switches
SC-3-2	Remove and Install a New Battery	IL-3-2	Circuit Breakers and Fuses
SC-3-3	Remove and Replace a Generator	IL-3-3	Bulbs and Wiring
SC-3-4	Remove and Replace an Alternator	IL-3-4	What The Battery Is and Does
		IL-3-5	The Alternator and How It Functions
		IL-3-6	Generator and Its Uses
		IL-3-7	Power Door Locks
		IL-3-8	Electric Window Controls
		IL-3-9	Hydraulic Electric Convertible Top Controls
		IL-3-10	Electric Power Seat Controls

Unit IV. Frame Work

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-4-1	Check for Sidesway, Sag and Mash	IL-4-1	Frame Repair Safety
SC-4-2	Check for Tracking	IL-4-2	The Use of Controlled Heat in Frame Repair
SC-4-3	Calibrate Front End Alignment Equipment	IL-4-3	General Description of Frames
SC-4-4	Adjust Caster (Wheel Alignment)	IL-4-4	Types of Frames
SC-4-5	Adjust Camber (Wheel Alignment)	IL-4-5	Types of Frame Damage
SC-4-6	Adjust Toe In (Wheel Alignment)	IL-4-6	The Key to Frame Straightening
		IL-4-7	Frame Specifications and Datum Line
		IL-4-8	Frame Repair Equipment and Safety Precautions
		IL-4-9	Frame and Body Estimating
		IL-4-10	Frame Checking Equipment
		IL-4-11	Front Suspension Nomenclature
		IL-4-12	Tire and Wheel Balance
		IL-4-13	Steering Gear

Unit V. Hydraulics

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-5-1	Hone a Cylinder	IL-5-1	Purpose of Brakes
		IL-5-2	How Brakes Stop the Vehicle
		IL-5-3	Construction of Brakes
		IL-5-4	Brake Lines
		IL-5-5	Power Brake Systems
		IL-5-6	Air Suspension
		IL-5-7	Concealed Head Lamps
		IL-5-8	Concealed Head Lamps (Trouble Shooting)

Unit VI. Air Conditioning

Skill Competencies/Operations
The student will be able to:

Information Lessons

- | | |
|--------|---|
| IL-6-1 | Air Conditioning |
| IL-6-2 | Air Conditioning Refrigerants |
| IL-6-3 | Air Conditioning Refrigerants
Safety Precautions |
| IL-6-4 | Troubleshooting Checklist |

Unit VII. Radiator Repair

Skill Competencies/Operations The student will be able to:		Information Lessons	
SC-7-1	Set Up and Light Prestolite Torch	IL-7-1	Cooling System Components and Types of Radiators
SC-7-2	Soft Solder with a Torch		

WRITTEN INSTRUCTIONAL AIDS

Introduction

Instruction sheets are aids used in developing the most effective and efficient teaching-learning situation that is possible. Four types of sheets are generally used including job sheets, operation sheets, information sheets and assignment sheets.

The Job involves a sequential performance of operations by the learner to "tryout" and develop the skill competencies (operations) of the occupation resulting in a product or service. It is the vehicle of instruction or the media by which the student practices and develops a series of skill competencies (operations). JOB SHEETS indicate to the student what to do in performing the various jobs assigned by the instructor. The jobs that will be used as vehicles of instruction in the course are listed in the COURSE OUTLINE section.

OPERATIONS are the subdivisions in the breakdown of a job. Each operation represents a process, way of doing or how to perform the particular skill competency or operation.

OPERATION SHEETS supplement the job sheets and indicate to the student how to perform the many skill competency operations necessary to complete the assigned jobs. The operations that will be taught in the course are listed in the COURSE OUTLINE section under skill competencies/operations. The operation sheets should be numbered to correspond with the Skill Competencies listed in the course outline.

INFORMATION SHEETS supplement the job sheets and provide the student with information necessary for completing the assigned jobs with highest possible degree of understanding. The information units that will be stressed in the course are listed in the course outline under information lessons. The information sheets included in this section should be numbered to correspond with the Information Lessons listed in the course outline.

ASSIGNMENT SHEETS supplement the job sheets and provide the student with mental activities necessary to learn the "knowing" that accompanies the "doing" of a trade. The student is assigned related studies or technical information to be "sought out" by the student on an individual basis through the use of problems or "exercises".

JOB: Weld a 6" Double Flange Weld

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tip
Welding Goggles

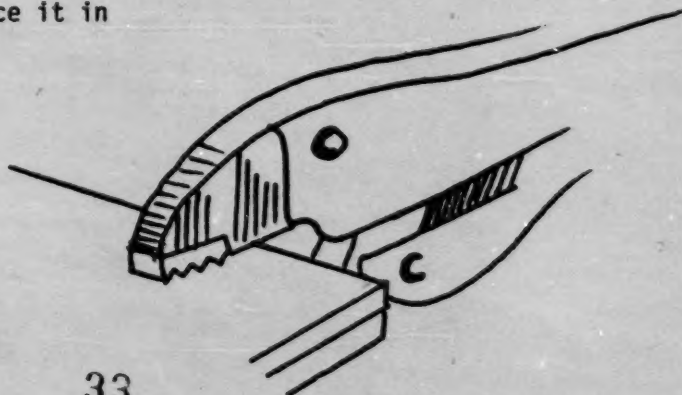
TOOLS: Lock-Joint Pliers
Vise Grip Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-1

Ball Peen Hammer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check the equipment for leaks.	
2. Process the two pieces of sheet metal.	. SC-1A-1
3. Place the two pieces of sheet metal back-to-back and lengthwise on welding table, then secure with vise-grip pliers at one end.	. SC-1A-2
4. Set up oxy-acetylene outfit.	. SC-1A-3
	NOTE: Clean tip if necessary.
5. Turn on, light and adjust torch for a neutral flame.	. SC-1A-4
6. Tack weld one end and the center of the joint.	
7. Weld the entire length of the joint, six inches.	. SC-1A-5
8. Turn off the torch and place it in the holder.	
9. Clean up the area.	



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METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper penetration of weld.
3. Uniform width of weld along entire length of weld.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Shut down of equipment
5. Safety in using welding equipment.
 - A. Type of clothing and footwear
 - B. Use of welding goggles
 - C. Removal of flammable materials
6. Time: 15 minutes.

JOB: Weld a 6" Butt Weld

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Bucket of Water
Two Firebricks
Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
One-1/16" or 3/32" Welding Rod

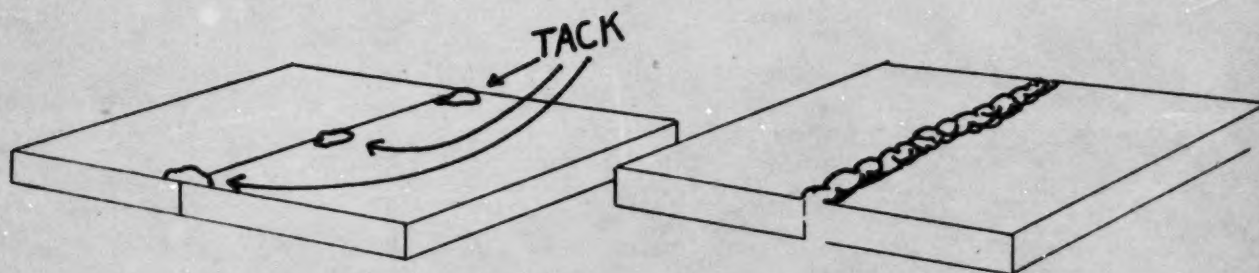
EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tip
Welding Goggles

TOOLS: Lock-Joint Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-2

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	NOTE: The butt weld takes a little longer to master than the flange weld.
2. Process the two pieces of sheet metal.	. SC-1A-1
3. Place the two firebricks on the welding bench, lengthwise, with a 1/2" space between them.	NOTE: Save the material produced in this job for a future job.
4. Place the two pieces of sheet metal on the bricks so the long sides (6") are next to each other. The edges of the two pieces should be over the space between the bricks.	. SC-1A-3 NOTE: Clean tip if necessary.
5. Turn on, light and adjust welding torch to a neutral flame.	. SC-1A-4
6. Tack weld the center joint and one end.	
7. Weld the two pieces of sheet metal together by slowly melting the welding rod into the weld as needed.	. SC-1A-6
8. Turn off the torch and place it in the holder.	
9. Clean up the area.	



METHOD OF EVALUATION:

The instructor will check for:

- A. Consistency of penetration.
- B. Width of weld.
- C. Consistency of weld structure.
- D. Quality of the weld.

JOB: Weld a 6" Lap Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-3

COURSE: Automotive Body and Fender

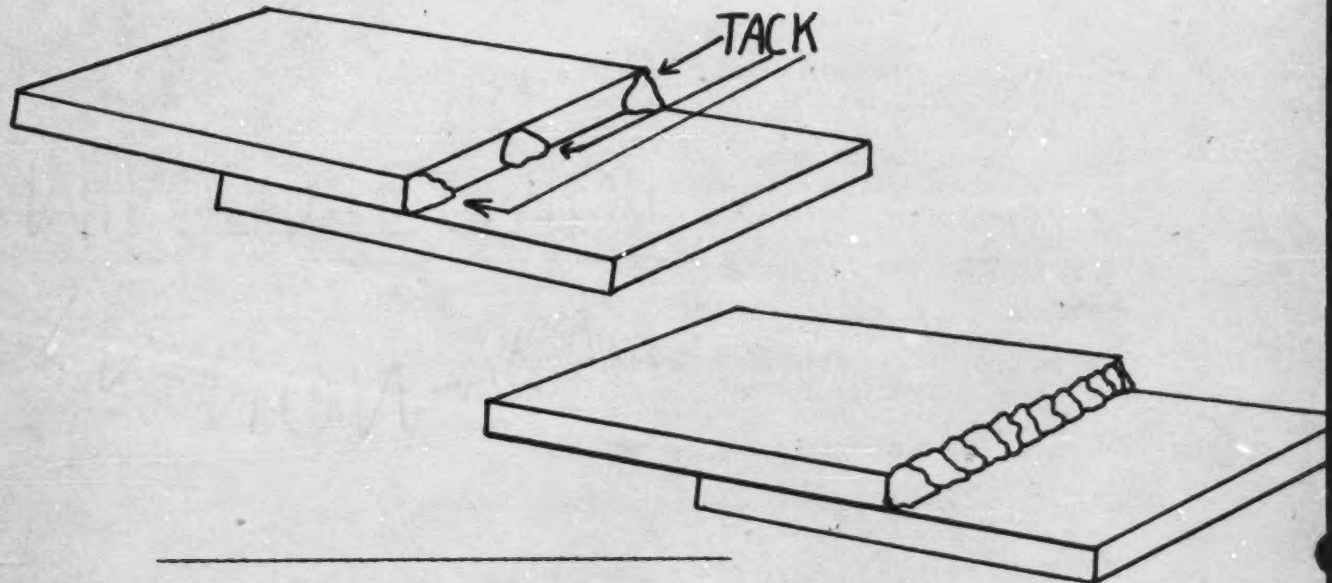
MATERIAL: Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
One Piece, 1/16" or 3/32" Weld Rod
Bucket of Water
Two Firebricks

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tip
Welding Goggles

TOOLS: Ball Peen Hammer
Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	
2. Process the two pieces of sheet metal.	. SC-1A-1
3. Place the two firebricks on the welding bench, lengthwise, with a 1/2" space between them.	
4. Place one piece of sheet metal on the firebricks, lengthwise. Place the other piece on top of the first, lengthwise, so that it covers one-half of the bottom piece. The joint you are to weld should be over the space between the firebricks.	NOTE: Clean tip if necessary. . SC-1A-3
5. Turn on, light and adjust welding torch to a neutral flame.	. SC-1A-4
6. Tack one end and the center of the joint.	. SC-1A-7
7. Weld the entire length of the joint. (6")	
8. Apply most of the heat to the bottom piece of metal.	NOTE: There will be a tendency for the top sheet to melt away from you. Turn the torch slightly away from the top piece and keep the filler rod between the torch and the top piece of metal.
9. Turn over and weld entire length of joint (6").	

10. Turn off the torch and place it in the holder.
11. Clean up the area.



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper penetration of weld.
3. Uniform width of weld along entire length of weld.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Shut down of equipment
5. Check for full weld at end of bead.
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes.

JOB: Weld a 6" Double Fillet Weld

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
One Piece, 1/16" or 3/32" Welding Rod
Bucket of Water
Two Firebricks

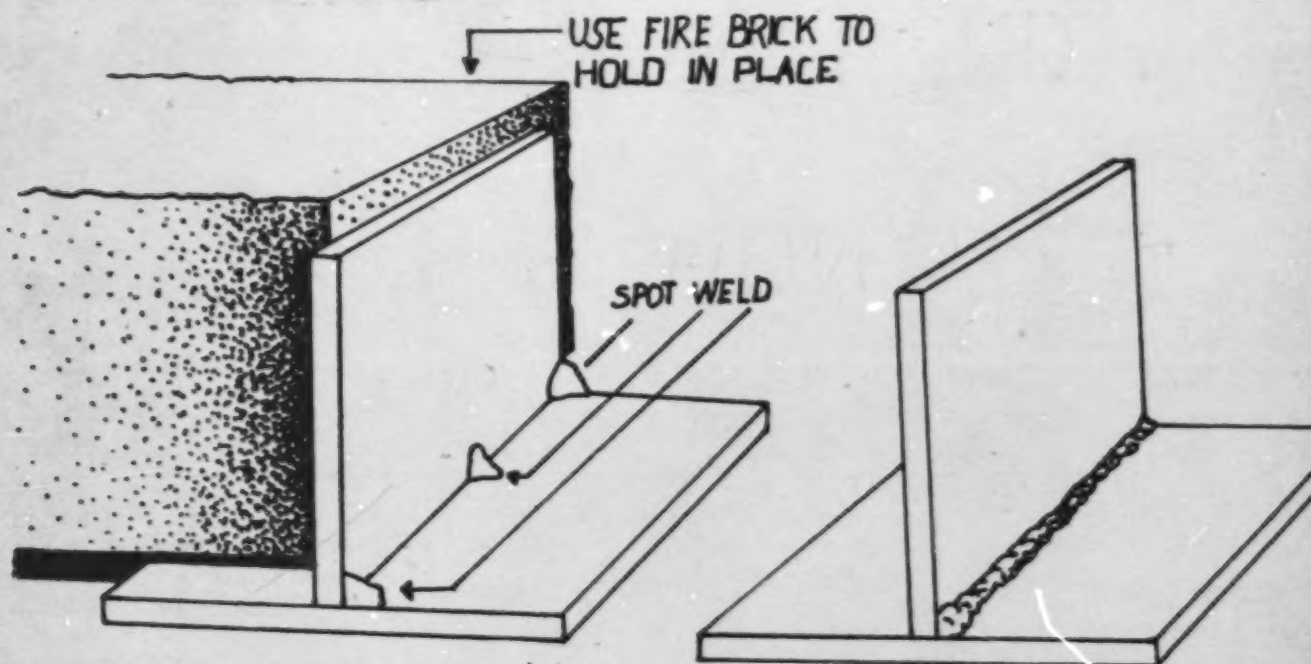
EQUIPMENT: Welding Goggles
Oxy-acetylene Welding Equipment with Proper Tip

TOOLS: Lock-Joint Pliers
Ball Peen Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-4

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	NOTE: The fillet weld demands a certain distribution of heat to properly complete the weld. There is a tendency to burn a hole in the vertical sheet. To avoid this, heat the vertical piece only enough to fuse the metal.
2. Process the two pieces of sheet metal.	
3. Place the two firebricks on the welding bench, lengthwise, with a 1/2" space between them.	
4. Place one piece of sheet metal so that it lies lengthwise on the firebricks, over the space between them. Stand the second piece of sheet metal upright on the first to form an upside down "T".	
5. Turn on, light and adjust welding torch to a neutral flame.	
6. Tack weld one end and the center of the joint.	. SC-1A-8
7. Weld both sides the entire length of the joint. (6")	
8. Turn off the torch and place it in the holder.	
9. Clean up the area.	



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper penetration of weld.
3. Uniform width of weld along entire length of weld and check for burning of holes in vertical sheet.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Handling of welding rod
 - C. Tip movement
 - D. Appropriate use of rod
 - E. Shut down of equipment
5. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
6. Time: 15 minutes.

JOB: Weld a 6" Multi-Bead Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-5

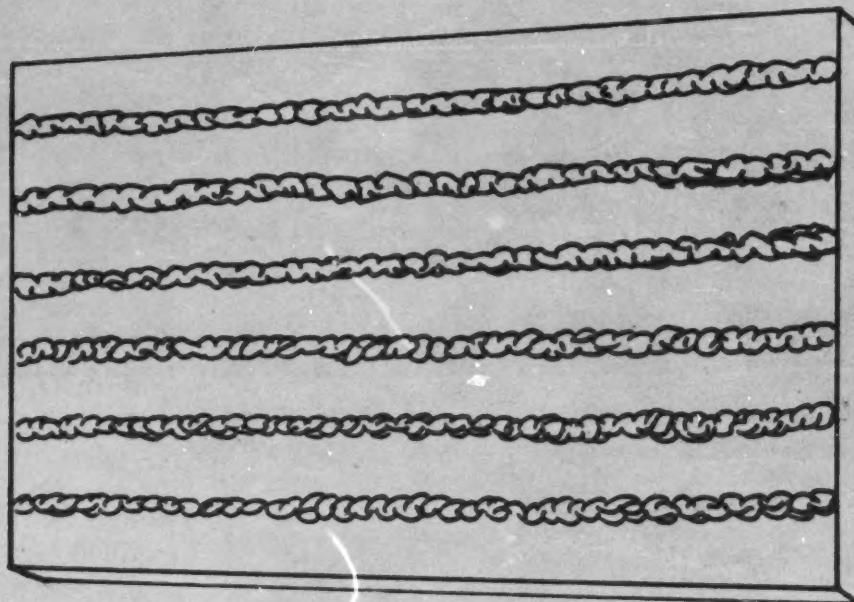
COURSE: Automotive Body and Fender

MATERIAL: One Piece, 20-22 Gage Sheet Metal, 6" X 6"
One Piece, 1/16" or 3/32" Welding Rod
Bucket of Water
Two Firebricks

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tip
Welding Goggles

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check the equipment for leaks.	
2. Process the sheet metal piece.	
3. Mark the metal with six equally spaced lines, parallel to one of the edges.	
4. Place the firebricks lengthwise on the welding bench, with a 1/2" space between them.	
5. Place the metal on the firebricks so that one of the marked lines is over the space between the bricks.	
6. Turn on, light and adjust welding torch to a neutral flame.	
7. Melt the metal and welding rod to form a bead along each of the marked lines.	. SC-1A-6 NOTE: Always place the line to be welded over the space between the bricks.
8. Turn off the torch and place it in the holder.	
9. Clean up the area.	

**METHOD OF EVALUATION:**

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper penetration of weld.
3. Uniform width of weld along entire length of weld.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Handling of weld rod
 - D. Shut down of equipment
5. Uniformity of width and heights of all six beads and check quality of weld and oxidation or carbonization.
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Braze a 6" Butt Joint

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-6

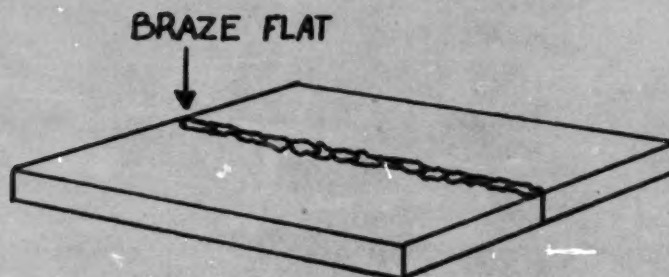
COURSE: Automotive Body and Fender

MATERIAL: Brazing Flux
One Piece, 1/16" or 3/32" Spelter Rod
Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
Bucket of Water
Two Firebricks

EQUIPMENT: Welding Goggles
Oxy-acetylene Welding Equipment

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	
2. Process the two pieces of sheet metal.	
3. Place the two firebricks on the welding table, lengthwise, with a 1/2" space between them.	
4. Place the two pieces of sheet metal on the bricks so the long sides (6") are next to each other. The edges of the two pieces should be over the space between the bricks.	
5. Turn on, light and adjust the welding torch to a neutral flame.	
6. Heat the spelter rod and tip into the flux.	
7. Tack one end and the center of the joint.	
8. Complete the braze from one end of the joint to the other. Heat metal to a dull red color and apply spelter rod to complete the weld.	. SC-1A-9
9. Turn off the torch and place it in the holder.	
10. Clean up the area.	



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper flow and penetration of weld, and uniform width of the braze bead.
3. Proper application of flux.
4. Check for over or under heating of the metal.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Angle and handling of spelter rod
 - C. Tip movement
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Braze a 6" Lap Joint
UNIT I: Metal Work
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

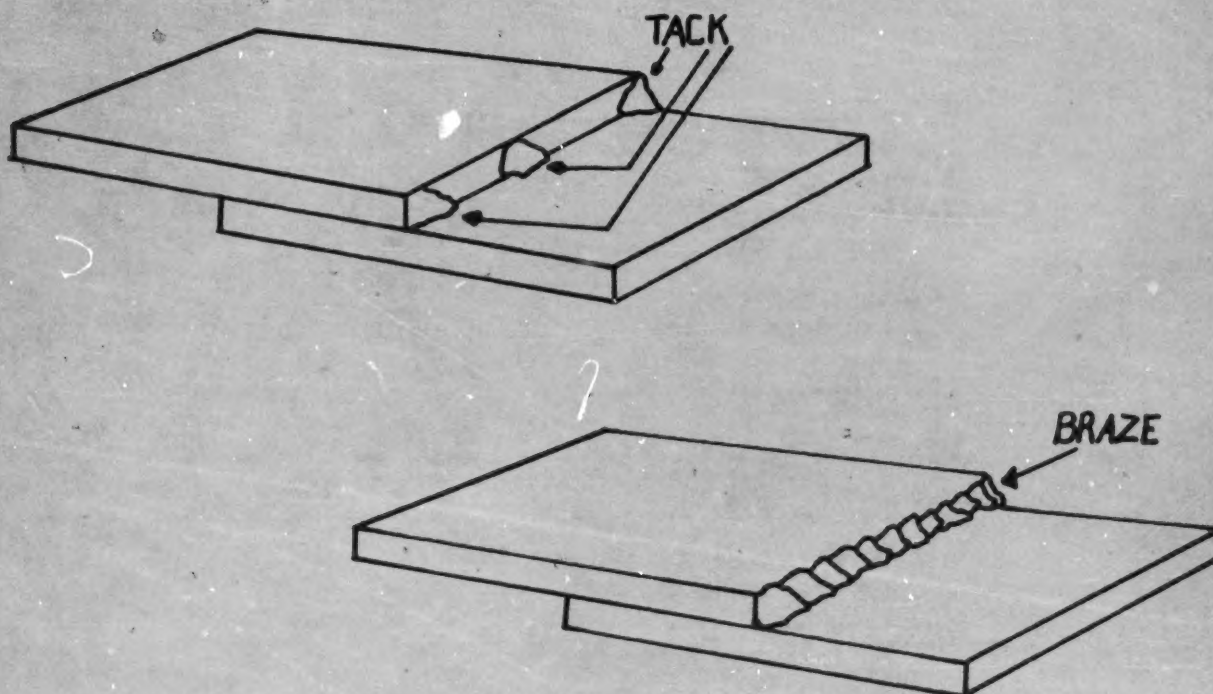
JOB NUMBER: J-1A-7

MATERIAL: Brazing Flux
Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
One Piece, 1/16" Spelter Rod
Bucket of Water
Two Firebricks

EQUIPMENT: Safety Goggles
Welding Goggles
Oxy-acetylene Welding Equipment with Proper Tip

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	
2. Process the two pieces of sheet metal.	
3. Place the two firebricks on the welding table, lengthwise, with a 1/2" space between them.	
4. Place one piece of sheet metal on the firebricks, lengthwise. Place the other piece on top of the first, lengthwise, so that it covers one-half of the bottom piece. The joint you are to braze should be over the space between the bricks.	
5. Turn on, light and adjust the welding torch to a neutral flame.	
6. Heat the spelter rod and tip into the flux.	
7. Tack one end and the center of the joint.	
8. Braze the entire length of the joint. (6")	SC-1A-9
9. Turn off the torch and place it in the holder.	
10. Clean up the area.	



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper flow and penetration of weld, and uniform width of the braze bead.
3. Proper application of flux.
4. Check for over or under heating of the metal.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Angle and handling of spelter rod
 - C. Tip movement
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Braze a 6" Fillet Section

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-8

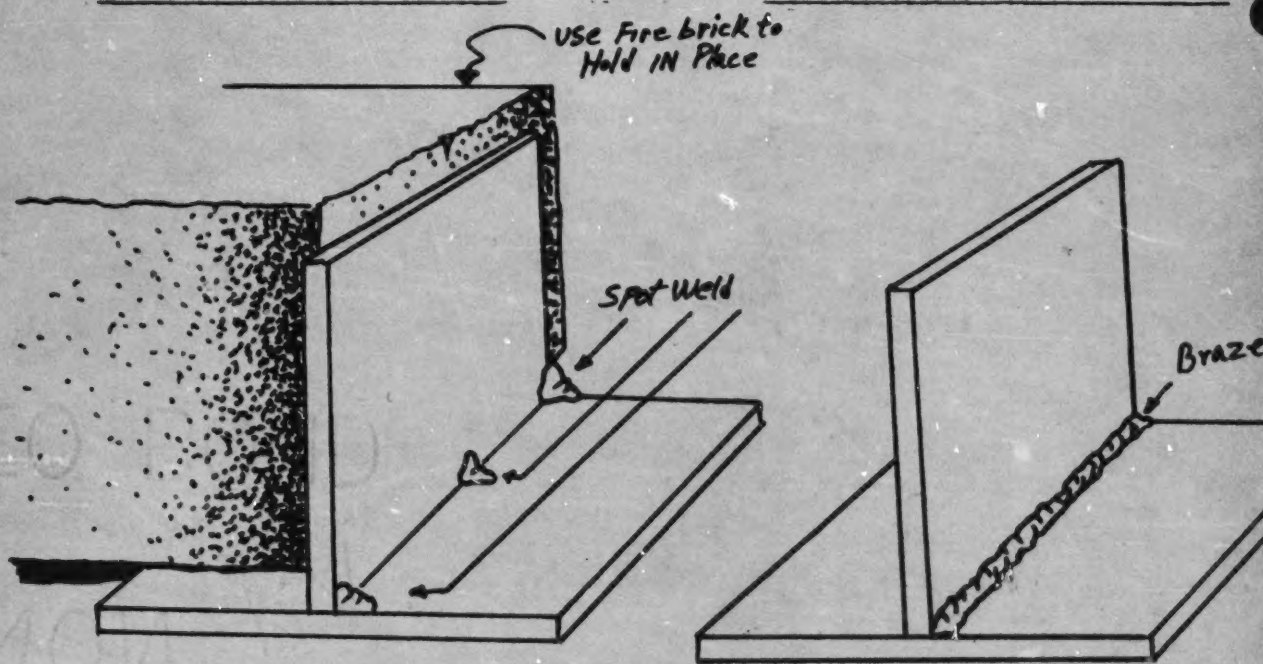
COURSE: Automotive Body and Fender

MATERIAL: Brazing Flux
Two Pieces, 20-22 Gage Sheet Metal, 3" X 6"
One Piece, 1/16" Spelter Rod
Bucket of Water
Two Firebricks

EQUIPMENT: Welding Goggles
Oxy-acetylene Welding Equipment with Proper Tip
Safety Goggles

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	
2. Process the two pieces of sheet metal.	
3. Place the two firebricks on the table, lengthwise, with a 1/2" space between them.	
4. Place one piece of sheet metal on the firebricks, lengthwise. Stand the other piece on edge on top of the first piece, lengthwise.	
5. Turn on, light and adjust welding torch to a neutral flame.	
6. Heat the spelter rod and dip it into the flux.	
7. Tack one end and the center of the joint.	
8. Braze the entire joint. (6")	. SC-1A-9
9. Shut down the torch and place it in the holder.	
10. Clean up the area.	



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper flow and penetration of weld, and uniform width of the braze bead.
3. Proper application of flux.
4. Check for over or under heating of the metal.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Angle and handling of spelter rod
 - C. Tip movement
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Cut Sheet Metal Car Panel with
Oxy-acetylene Cutting Torch

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-9

COURSE: Automotive Body and Fender

MATERIAL: Old Car Panel
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
Cutting Tip
Safety Goggles
Welding Goggles
Gloves

TOOLS: Lock-Joint Pliers

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Clear the area of flammable materials and check equipment for leaks.	
2. Mark the cutting line you want to follow.	. SC-1A-10
3. Turn on, light and adjust cutting torch to a neutral flame.	NOTE: Avoid side-to-side movement of torch, as a ragged edge will result and the cutting action may stop. NOTE: For safety reasons, you should wear high-top shoes and avoid pants with cuffs.
4. Heat metal to proper color, press the cutting lever to start the cut and move the torch forward as rapidly as the metal will cut.	. SC-1A-11
5. Turn off the torch and place it in the holder.	
6. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjustment of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper position of material for cutting.
3. Straightness of cutting edge.
4. Clean cutting edge.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Level or trigger operation
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Cut In 1/8" Steel Plate with
Oxy-acetylene Torch, Six Inch

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-10

COURSE: Automotive Body and Fender

MATERIAL: One Piece, 1/8" Steel Plate, 3" X 6"
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
Cutting Tip
Welding Goggles
Gloves
Safety Goggles

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear area of flammable materials and check equipment for leaks.	NOTE: For safety reasons, you should wear high-top shoes and avoid pants with cuffs.
2. Mark cutting line to be followed.	
3. Place steel plate on welding table.	CAUTION: DO NOT PLACE PLATE ON FLOOR OR OTHER CONCRETE SURFACE, OR ANY FLAMMABLE SURFACE. Allow a space under the cutting line for hot sparks to escape.
4. Turn on, light and adjust cutting torch to a neutral flame.	. SC-1A-10
5. Heat metal to proper color and cut.	. SC-1A-11 NOTE: Avoid side-to-side movement of the torch, as a ragged edge will result and cutting action may stop.
6. Turn off the torch and place it in the holder.	
7. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper position of material for cutting.
3. Clean cutting edge.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Lever or trigger operation
 - D. Shut down of equipment
5. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
6. Time: 15 minutes

JOB: Cut 3/8" Steel Plate with
Oxy-acetylene Torch, Six Inch

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1A-11

COURSE: Automotive Body and Fender

MATERIAL: One Piece, 3/8" Steel Plate, 6" X 6"
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding
Cutting Tip
Safety Goggles
Welding Goggles
Gloves

TOOLS: Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clean area of flammable materials and check equipment for leaks.	NOTE: For safety reasons, you should wear high-top shoes and avoid pants with cuffs.
2. Mark cutting line to be followed.	
3. Place steel plate on welding table.	
4. Turn on, light and adjust cutting torch to a neutral flame.	. SC-1A-10
5. Heat to proper color and cut.	. SC-1A-12 NOTE: Make sure that the torch tip is at 90° to the metal being cut.
6. Turn off the torch and place it in the holder.	
7. Clean up the area.	NOTE: Avoid side-to-side movement of the torch, as a ragged edge will result and the cutting action may stop.

METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper position of material for cutting.
3. Straightness of cut edge.
4. Clean cutting edge.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Lever or trigger operation
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Cut Rivets and Bolts From Frame

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Old Frame Section with Rivets and Bolts Attached
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
Cutting Tip
Safety Goggles
Welding Goggles
Gloves

TOOLS: Lock-Joint Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-12

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clear the area of flammable materials and check equipment for leaks.	NOTE: You should wear high-top shoes and avoid pants with cuffs.
2. Mark the rivets and bolts to be cut.	
3. Turn on, light and adjust cutting torch to a neutral flame.	
4. Hold torch tip parallel to the frame about 3/16" away from the rivet head or nut to be cut and heat to dull red color.	. SC-1A-11 . SC-1A-12
5. Cut the rivet head or nut with intermittent cutting action (little by little).	NOTE: Caution should be exerted not to cut the frame.
6. Turn off the torch and place it in the holder.	
7. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper position of material for cutting.
3. Clean cutting edge - no cut in frame.
4. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Handling of welding rod
 - D. Shut down of equipment
5. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
6. Time: 15 minutes

JOB: Weld a 6" Cut in a Fender

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Old Fender
One Piece, 1/16" or 3/32" Welding Rod
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tip
Welding Goggles
All-Purpose Dolly

TOOLS: Welding Pliers
Metal Body Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-13

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Any cut over 3" long should be skip welded.
2. Clean undercoating from the area to be welded.	NOTE: This job may be saved for plastic filling later on.
3. Repair the metal around the cut or tear with the hammer and all-purpose dolly.	NOTE: If the damage is on the edge of the fender, hold the ends of the cut together with the welding pliers.
4. Turn on, light and adjust welding torch to a neutral flame.	
5. Tack weld and weld entire length of the cut. (Weld the cut, starting at the solid end if the cut is on the edge of the fender.)	. SC-1A-7 . SC-1A-8
6. Turn off the torch and place in holding device.	
7. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper cleaning and preparation of old fender.
3. Total penetration of weld.
4. Uniform width of weld along entire length of weld.
5. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Handling of welding rod
 - D. Shut down of equipment
6. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
7. Time: 15 minutes

JOB: Braze a 6" Square Patch Panel
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: One Piece, 20-22 Gage Sheet Metal
24 Grit Open-Coat Disc
1/16" Spelter Rod
Brazing Flux
EQUIPMENT: Panel Cutting Equipment
Oxy-acetylene Welding Equipment
Proper Tip
Welding Goggles
TOOLS: Electric Drill
Disc Grinder
Body Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1A-14

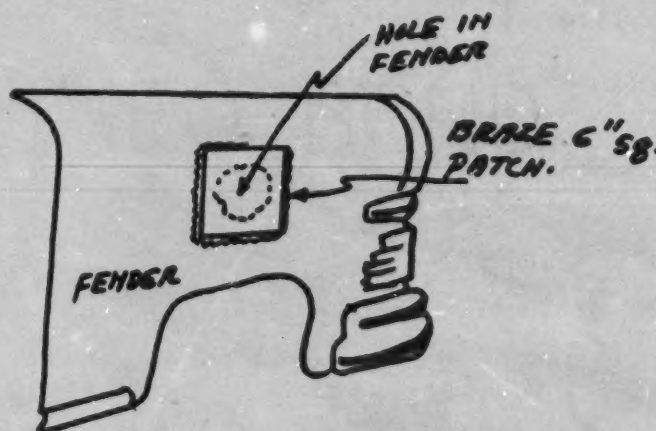
Bucket of Water
Pop Rivet Kit
Used Panel

Safety Goggles
1/8" Drill Bit
All-Purpose Dolly

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Clean undercoating around damaged area.
3. Rough out and align if necessary.
4. Remove paint from damaged area.
5. Remove rusted area OR install patch over rusted area.
6. Braze the patch to the panel, following a 1/2" braze, 1/2" skip pattern.
7. Turn off the torch and place it in the holder.
8. Clean up the area.



METHOD OF EVALUATION:

1. Proper setting and adjusting of welding equipment.
 - A. Tank gage settings
 - B. Adjusting to neutral flame
2. Proper preparation of used panel.
3. Proper flow and uniform width of braze bead.
4. Proper application of flux.
5. Check for over or under heating the metal.
6. Proper handling of welding equipment.
 - A. Angle of torch tip
 - B. Tip movement
 - C. Handling of welding rod
 - D. Shut down of equipment
7. Handling of tools - disc grinder, metal hammer, pop rivet kit, all-purpose dolly and electric drill.
8. Safety in using welding equipment.
 - A. Type of clothing and foot wear
 - B. Use of welding goggles
 - C. Removal of flammable materials
9. Time: 20 minutes

JOB: Electric Weld Short Beads

JOB SHEET
IDENTIFICATION CODE

UNIT 1: Metal Work

JOB NUMBER: J-1B-1

COURSE: Automotive Body and Fender

MATERIAL: Scrap 5/16" Mild Steel, 4" X 6"
1/8" E-6014 Electrodes (Instructor's Choice)
Welding Strips

EQUIPMENT: Arc Welder
Welding Helmet or Shield
Welding Bench in an Enclosed Area

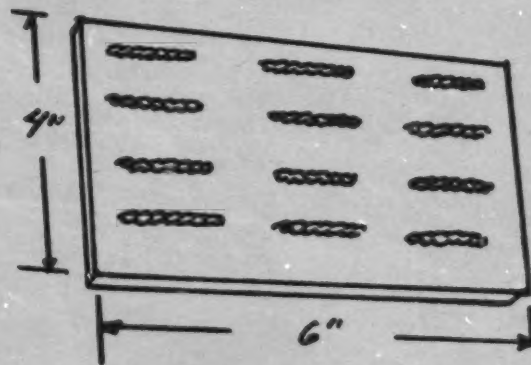
Safety Goggles
Welding Gloves

TOOLS: Chipping Hammer
Wire

Pliers

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Analyze job.
2. Select metal and cut to size (if not pre-cut).
3. Position material for welding.
4. Connect ground clamps and insert electrode in the holder.
5. Adjust welder.
6. Turn on welder.
7. Lower the helmet.
8. Strike an arc.



NOTE: Hold rod at 50° angle to the plate for normal welding.

9. Repeat steps 7 and 8 until the instructor's approval is met.

METHOD OF EVALUATION:

1. Check penetration.
2. Check width and uniformity of weld.
3. Check for appropriate equipment setting.
4. Cut across weld and evaluate.
5. Time: 35 minutes

JOB: Electric Weld a Butt Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1B-2

COURSE: Automotive Body and Fender

MATERIAL: 1/4" Steel 2" X 6" (Mild)
1/4" Steel 2" X 6" (Mild)
Instructor's Choice 1/8" Electrodes E-6014

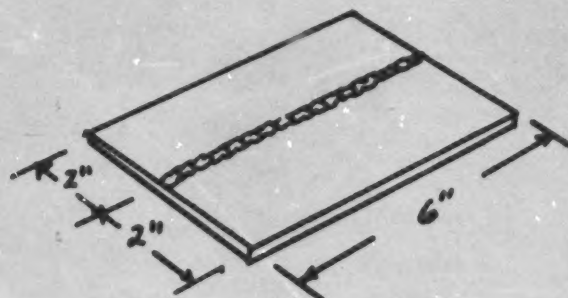
EQUIPMENT: Arc Welder
Welding Helmet or a Shield
Welding Bench in an Enclosed Area

Safety Goggles
Welding Gloves

TOOLS: Chipping Hammer
Wire Brush

Pliers

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Analyze the job.	
2. Select metal and cut to size (if not pre-cut).	
3. Prepare bench and set up job.	
4. Connect ground clamp and insert electrode in the holder.	
5. Adjust welder.	
6. Turn on welder.	
7. Lower the helmet.	
8. Tack weld the opposite end of area to be welded.	
9. Strike an arc and moving the rod back and forth melt both pieces of metal together.	. SC-1B-1
10. Repeat step 9 until the instructor's approval is met.	NOTE: All flammable material should be removed from the area.



METHOD OF EVALUATION:

1. Check penetration.
2. Check width and uniformity of weld.
3. Check for appropriate equipment setting.
4. Evaluate break test.
5. Time: 35 minutes

JOB: Electric Weld a Fillet Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1B-3

COURSE: Automotive Body and Fender

MATERIAL: 1/4" Steel 1" X 4" (Mild)
1/4" Steel 2" X 4" (Mild)
Instructor's Choice 1/8" Electrodes E-6011, E-6013, E-6014

EQUIPMENT: Arc Welder
Welding Helmet or a Shield
Welding Bench in an Enclosed Area

Safety Goggles
Welding Gloves

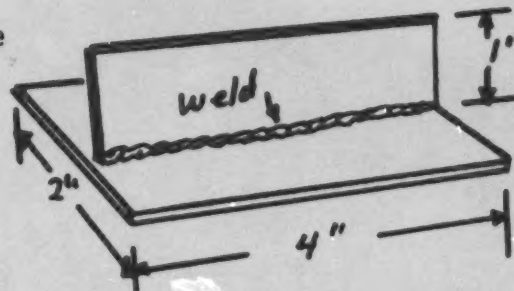
TOOLS: Chipping Hammer
Wire Brush

Pliers

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Select metal and cut to size (if not pre-cut).
3. Prepare bench and set up job.
4. Connect ground clamp and insert electrode in the holder.
5. Adjust welder.
6. Turn on welder.
7. Lower the helmet.
8. Tack weld the opposite end of area to be welded.
9. Strike an arc and moving the rod back and forth melt both pieces of metal together.
10. Repeat step 9 until the instructor's approval is met.



. SC-1B-1

NOTE: All flammable material should be removed from the area.

METHOD OF EVALUATION:

1. Check penetration.
2. Check width and uniformity of weld.
3. Check for appropriate equipment setting.
4. Evaluate break test.
5. Time: 35 minutes

JOB: Electric Weld a Lap Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1B-4

COURSE: Automotive Body and Fender

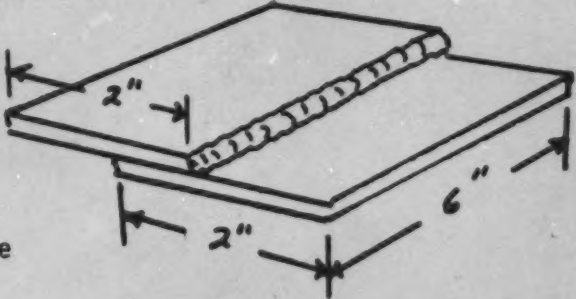
MATERIAL: 1/16" Steel 2" X 6"
1/16" Steel 2" X 6"
Instructor's Choice 1/8" Electrodes E-6014

EQUIPMENT: Arc Welder
Welding Bench in an Enclosed Area
Welding Helmet or Shield

Safety Goggles
Welding Gloves

TOOLS: Chipping Hammer
Pliers

Wire Brush

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Select metal and cut to size (if not pre-cut). 3. Prepare bench and set up job. 4. Connect ground clamp and insert electrode in the holder. 5. Adjust welder. 6. Turn on welder. 7. Lower the helmet. 8. Tack weld the opposite end of area to be welded. 9. Strike an arc and moving the rod back and forth melt 10. Repeat step 9 until the instructor's approval is met.	 . SC-1B-1 NOTE: All flammable material should be removed from the area.

METHOD OF EVALUATION:

1. Check penetration.
2. Check width and uniformity of weld.
3. Check for appropriate equipment setting.
4. Evaluate break test.
5. Test: 35 minutes

JOB: Spot Weld

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1B-5

COURSE: Automotive Body and Fender

MATERIAL: 2 Pieces, Scrap Sheet Metal (Gage 18-22) 2" X 12"
1/8" and 5/64" Electrodes for Spot Welder
Bucket of Water

EQUIPMENT: Welding Bench in an Enclosed Area
Welding Grips
Spot Welder, Arc

Safety Goggles
Welding Goggles

TOOLS: Hammer

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze job.	
2. Select metal and cut to size (if not pre-cut).	
3. Adjust welder.	
4. Turn on welder.	
5. Hold the spot welder tips against the metal.	
6. Apply pressure on the welder tips and pull the trigger until fusion is complete.	. SC-1B-2
7. Repeat steps 7 and 8 until the spot welds are completed.	
8. Clean up area.	NOTE: All flammable material should be removed from the area.

METHOD OF EVALUATION:

1. Check spot penetration.
2. Check for appropriate equipment setting.
3. Evaluate break test.
4. Time: 25 minutes

JOB: Solder a 6" Butt Welded Seam,

UNIT 1: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: #24 Open-Coat Grinding Disc
1 Butt Welded Seam
#24 Mushroom Disc

EQUIPMENT: Oxy-acetylene Welding Equipment
Soldering Tip or Adapter
Mushroom Pad

TOOLS: Disc Sander
Rotary Wire Brush
Electric Drill

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1C-1

1 Bar 30/70 Body Solder
Tinning Material

Safety Goggles
Soldering Paddles
Wax Container

Lock-Joint Pliers
Scrapers ("Broken File")
Body File

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Grind the surface to be soldered 2" beyond damage.	NOTE: Trim disc if necessary. NOTE: Broken file for scraping paint and rust from small areas. . SC-1C-2
2. Prepare metal for tinning.	. SC-1C-1, SC-1C-3, SC-1C-4
3. Tin the area to be soldered 1 1/2" beyond damage.	
4. Turn on, light and adjust welding torch for soldering.	
5. Apply solder and smooth to general contour with paddles.	. SC-1C-4
6. After solder cools, remove the excess with with body file.	. SC-1C-8
7. Shut down the welding equipment.	
8. Clean up the area.	

METHOD OF EVALUATION:

1. Proper use of equipment.
2. Proper setting and adjusting of soldering equipment.
 - A. Tank gage settings
 - B. Adjusting to carburizing flame
3. Proper preparation of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Tinning process
 - C. Proper cleaning of surface area
 - D. Uniform contouring of solder to metal contour.
4. Proper use of body file to remove excess solder.
5. Proper shut down of equipment.
6. Safety in use of soldering equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Removal of flammable material
7. Time: 45 minutes

JOB: Solder a 9" Square Dent in Hood or Trunk Lid

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-2

COURSE: Automotive Body and Fender

MATERIAL: #24 Open-Coat Grinding Disc
1 Bar 30/70 Body Solder
Tinning Material
#24 Mushroom Disc

EQUIPMENT: Oxy-acetylene Welding Equipment
Solder Tip or Adapter
Mushroom Pad

Safety Goggles
Soldering Paddles
Wax Container

TOOLS: Disc Sander
Electric Drill
Rotary Wire Brush

Body File
Lock-Joint Pliers
Scrapers ("Broken File")

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Grind the surface to be soldered 2" beyond damage.	NOTE: Trim disc if necessary . SC-1C-2
2. Prepare metal for tinning.	
3. Tin the area to be soldered 1 1/2" beyond damage.	NOTE: Use a broken file for scraping paint and rust from small areas. . SC-1C-1, SC-1C-3, SC-1C-4
4. Turn on, light and adjust welding torch for soldering.	
5. Apply solder and smooth to general contour with paddles.	. SC-1C-5
6. Shut down the welding equipment.	
7. After solder cools, remove excess with a body file.	. SC-1C-6
8. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjusting of soldering equipment.
 - A. Tank gage settings
 - B. Adjusting to carburizing flame
2. Proper preparations of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Tinning process
 - C. Proper cleaning of surface area
 - D. Uniform contouring of solder to metal contour
3. Proper use of body file to remove excess solder.
4. Check for metal distortion.
5. Proper shut down of equipment.
6. Safety in use of soldering equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Removal of flammable material
7. Time: 30-40 minutes

JOB: Solder a 9" Square Dent in a Door

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: #24 Open-Coat Grinding Disc
1 Bar 30/70 Body Solder
Tinning Material
#24 Mushroom Disc

EQUIPMENT: Oxy-acetylene Welding Equipment
Solder Tip or Adapter
Mushroom Pad

TOOLS: Rotary Wire Brush
Disc Sander
Electric Drill

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1C-3

Safety Goggles
Soldering Paddles
Wax Container

Body File
Scrapers ("Broken File")
Lock-Joint Pliers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Grind the surface to be soldered 2" beyond damage.	NOTE: Trim disc if necessary. . SC-1C-2
2. Prepare metal for tinning.	NOTE: Use a broken file for scraping paint and rust from small areas. . SC-1C-1, SC-1C-3, SC-1C-4
3. Tin the area to be soldered 1 1/2" beyond damage.	
4. Turn on, light and adjust welding torch for soldering.	
5. Apply solder and smooth to general contour with paddles.	. SC-1C-7
6. Shut down the welding equipment.	
7. After solder cools, remove excess with a body file.	. SC-1C-6
8. Clean up the area.	

METHOD OF EVALUATION:

1. Proper use of equipment.
2. Proper setting and adjusting of soldering equipment.
 - A. Tank gage settings
 - B. Adjusting to carburizing flame
3. Proper preparation of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Tinning process
 - C. Proper cleaning of surface area
 - D. Uniform contouring of solder to metal contour
4. Proper use of body file to remove excess solder.
5. Check for metal distortion.
6. Proper shut down of equipment.
7. Safety in use of soldering equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Removal of flammable material
8. Time: 30 minutes

JOB: Solder a 9" Square Dent on the Door Opening

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-4

COURSE: Automotive Body and Fender

MATERIAL: #24 Open-Coat Grinding Disc
1 Bar 30/70 Body Solder
Tinning Material
#24 Mushroom Disc

EQUIPMENT: Solder Tip or Adapter
Oxy-acetylene Welding Equipment
Soldering Paddles

Safety Goggles
Mushroom Pad
Wax Container

TOOLS: Scrapers ("Broken File")
Lock-Joint Pliers
Rotary Wire Brush

Disc Sander
Body File
Electric Drill

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Grind the surface to be soldered 2" beyond damage.	NOTE: Use a broken file for scraping paint and rust from small areas.
2. Prepare surface to be tinned.	
3. Tin the area to be soldered 1 1/2" beyond damage.	
4. Turn on, light and adjust welding torch for soldering.	
5. Apply solder and smooth to general contour with paddles.	. SC-1C-8
6. Shut down the welding equipment.	
7. After solder cools, remove excess with a body file.	
8. Clean up the area.	

METHOD OF EVALUATION:

1. Proper setting and adjusting of soldering equipment.
 - A. Tank gage settings
 - B. Adjusting to carburizing flame
2. Proper preparations of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Tinning process
 - C. Proper cleaning of surface
 - D. Uniform contouring of solder to metal contour
3. Proper use of body file to remove excess solder.
4. Safety in use of soldering equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Removal of flammable material
5. Time: 25-30 minutes

JOB: Fill a 9" Square Dent in Hood or Trunk with Plastic

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-5

COURSE: Automotive Body and Fender

MATERIAL: Body Filler (Plastic with Hardener)
#24 Open-Coat Grinding Disc
#40 and #60 Abrasive Paper
Mixing Surface, 150 Square Inch Glass or Metal

EQUIPMENT: Mushroom Pad
Safety Goggles

TOOLS: Disc Sander
Electric Drill
Scrapers
Speed File

Rotary Wire Brush
Putty Knife
Spreaders, Plastic

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clean surface to be filled 2" beyond damage.	NOTE: Filler material hardens quickly. Do not mix more than is needed for the job, and apply immediately.
2. Mix filler materials.	. SC-1C-9
3. Apply filler materials with plastic spreader.	NOTE: Unused filler mixed with hardener should never be returned to the original container.
4. After curing, file and sand to proper contours.	
5. Clean up the area.	

METHOD OF EVALUATION:

1. Proper preparation of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Proper cleaning of surface area
 - C. Uniform contouring of filler to metal contour
2. Proper use of grinder.
3. Proper use of body file or sander to remove excess filler.
4. Check to see if an over amount of filler was mixed or was unused mixed filler returned to can?
5. Safety in use of equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Proper use of flammable materials in clean up
6. Time: 20 minutes

Fill a 9" Square Dent in Door
with Plastic

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-6

COURSE: Automotive Body and Fender

MATERIAL: Body Filler (Plastic with Hardener)
#24 Open-Coat Grinding Disc
#40 and #60 Abrasive Paper
Mixing Surface, 150 Square Inch Glass or Sheet Metal

EQUIPMENT: Mushroom Pad
Safety Goggles

TOOLS: Disc Sander
Electric Drill
Rotary Wire Brush
Scrapers

Speed File
Putty Knife
Spreaders, Plastic

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Clean surface to be filled 2" beyond damage.
2. Mix filler materials.
3. Apply filler materials with plastic spreader.
4. After curing, file and sand to proper contours.
5. Clean up the area.

NOTE: Filler material hardens quickly. Do not mix more than is needed for the job, and apply immediately.

NOTE: Unused filler mixed with hardener should never be returned to the original container.

. SC-1C-9

METHOD OF EVALUATION:

1. Proper preparation of metal.
 - A. Grinding of surface beyond area to be filled
 - B. Proper cleaning of surface area
 - C. Uniform contouring of filler to metal contour
2. Proper use of grinder.
3. Proper use of body file or sander to remove excess filler.
4. Proper clean up of tools.
5. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
6. Safety in use of equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Proper use of flammable materials in clean up
7. Time: 20 minutes

JOB: Fill a 9" Square Dent in a Rocker Panel
with Plastic

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-7

COURSE: Automotive Body and Fender

MATERIAL: Body Filler (Plastic with Hardener)
#24 Open-Coat Grinding Disc
#40 and #60 Abrasive Paper
Mixing Surface, Approximately 150 Square Inches

EQUIPMENT: Mushroom Pad
Safety Goggles

TOOLS: Disc Sander
Electric Drill
Rotary Wire Brush
Scrapers

Speed File (Hand)
Putty Knife
Spreaders, Plastic

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Clean surface to be filled 2" beyond damage.

2. Mix filler materials.

NOTE: Filler material hardens quickly. Do not mix more than is needed for the job, and apply immediately.

NOTE: Unused filler mixed with hardener should never be returned to the original container.

3. Apply filler materials with plastic spreader.

. SC-1C-9

4. After curing, file and sand to proper contours.

5. Clean up the area.

METHOD OF EVALUATION:

1. Proper preparation of metal
 - A. Grinding of surface beyond area to be filled
 - B. Proper cleaning of surface area
 - C. Uniform contouring of filler to metal contour
2. Proper use of grinder.
3. Proper use of body file or sander to remove excess filler.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Proper clean up of tools.
6. Safety in use of equipment.
 - A. Type of clothing and foot wear
 - B. Safety goggles
 - C. Proper use of flammable materials in clean-up
7. Time: 20 minutes

JOB: Repair Fiberglass--Large or Small Hole

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1C-8

COURSE: Automotive Body and Fender

MATERIAL: #36, #60 and #80 Disc
Resin Repair Kit
Hack Saw Blade
Polyethylene, Glass or Sheet Metal

EQUIPMENT: Respirator
Goggles

TOOLS: Disc Grinder
Clamps
Spatula
Body File
Squeegee

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove damaged material such as loose fiberglass	
2. Grind off the paint and gel coat to get down to the raw fiberglass, on both the outside and inner surfaces.	. SC-1C-10
3. Cut two pieces of mat so that they will extend past the edges of the hole about 2" inside and outside.	
4. Mix resin with hardener (directions on can).	
5. Lay a polyethylene sheet on the bench.	NOTE: Save the poly bags from the uniforms returned from the cleaners.
6. Put on a pair of plastic gloves to protect the hands from glass fibers and from the resin.	
7. Place the fiberglass mat on the plastic and pour a small amount of the mixed resin onto the fiberglass.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Using the special spatula, work the resin back and forth until the mat is thoroughly saturated. 9. Lay one piece on the inner surface, working it well to squeeze the resin through the mat and work out any air bubbles. 10. Place the other piece on the outside of the break, working it into place. 11. Allow the material to harden; then roughen the surface with a course sanding disc, and feather the edges. 12. Apply a fiberglass filler to smooth out the entire surface. 13. Allowing time for the filler to harden, smooth the outside surface, feathering it out prior to painting. 14. Clean up are area.	NOTE: There will be a slight indentation where the mat bridges the hole. Do not worry about this, but leave it as is.

METHOD OF EVALUATION:

1. Check on use of safety equipment and techniques.
2. Time: 4 hours

JOB: Repair Fiberglass--Broken or Shattered Area

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Hack Saw Blade
Resin Repair Kit
Polyethylene, Glass or Metal Sheet

EQUIPMENT: Respirator
Goggles

TOOLS: Disc Grinder
Clamp
Spatula
Squeegee
File (Body)

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1C-9

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Working from the back side, remove the dirt from all of the pieces and from the edges of the main structure.	
2. Find the pieces that mates to the main structure.	. SC-1C-10
3. Clamp into place.	
4. Smear a coating of canned fiberglass on both pieces; building a bridge of canned fiberglass over the crack.	
5. Repeat this process with each one of the pieces until all of the broken fragments have been glued together into one very rough but basically proper shaped piece.	
6. With a rough disc #24 grind the whole outer surface to shape	NOTE: At this point, check for rigidity. It may well require additional canned fiberglass as reinforcement on the back side of the panel. All of the raw edges will be exposed on the outside.

NOTE: Remove all the high points and corners, leaving a thin fender shaped shell patched together with canned fiberglass.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Make a complete rebuild by taking a fiberglass mat, cutting pieces about one foot square (or whatever size is adequate) and laying them onto this form or thin shell.	NOTE: Procedure would be the same as in repairing holes.
8. Wet out the mat and roll it into place.	NOTE: This is best done by shingling the area. Do not try to work with pieces that are too large. The edges taper off as they are rolled out and will be ground to shape upon finishing. To get the proper thickness will require two to three layers of mat and these will be shingled into place. After rough grinding the entire surface, a coating of fiberglass plastic is applied. The job is then ready for refinishing process.

METHOD OF EVALUATION:

1. Selection of appropriate selection of materials.
2. Proper ratio of materials used.
3. Correct selection and use of grinding materials.
4. Overlap of layers of fiberglass for correct taper.
5. Proper safety precautions.
 - A. Respirator must be worn
 - B. Safety goggles
 - C. In use of grinding equipment
 - D. Use of protection creams
6. Time: 4 hours

JOB: Repair a 100 Square Inch Dent in
a Front Fender

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-1

COURSE: Automotive Body and Fender

MATERIAL: #24 Open-Coat Disc
1/16" or 3/32" Welding Rod
#50 Closed-Coat Disc
Beeswax
Bucket of Water

1 Bar, 30/70 Body Solder or
Plastic Filler
Tinning Material
Damaged Fender
Solder Paddles

EQUIPMENT: Oxy-acetylene Welding Equipment
Welding Goggles
Gloves (Optional)

Safety Goggles
Dollies (Instructor's Choice)

TOOLS: Body File
Carbon Scraper or Putty Knife
Body Hammers
Slapper

Specialized Tools
(Instructor's Choice)
Disc Grinder

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: This job is strictly a straightening process.
2. Remove undercoating from damaged area.	NOTE: Avoid overworking the metal, as it may stretch.
3. Rough out and align damaged area.	
4. Weld or shrink if necessary.	
5. Metal finish the damaged area.	NOTE: When hot shrinking, do not heat an area any larger than a nickel.
6. Grind the damaged area.	
7. Fill if necessary, by using solder or plastic.	. SC-1D-1
8. Clean up the area.	. SC-1D-2

METHOD OF EVALUATION:

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper
disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 40 hours

JOB: Repair a 100 Square Inch Dent in a Door

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-2

COURSE: Automotive Body and Fender

MATERIAL: Damaged Door
Beeswax
#50 Closed-Coat Disc
Tinning Material
Bucket of Water

1 Bar 30/70 Body Solder or
Plastic Filler
Allen Wrench Set
#24 Open-Coat Disc
Solder Paddles

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding and
Soldering)
Gloves (Optional)

Dollies (Instructor's Choice)
Safety Goggles
Welding Goggles

TOOLS: Carbon Scraper or Putty Knife
Body Spoons
Pick Bars
Upholstery Tools
Body Hammers
Panel Cutter
1/4" Drive Socket Set

Phillips Screwdrivers
Straight Screwdrivers
Speed and Body File
Disc Grinder
Slapper
Specialized Tools (Instructor's
Choice)

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: This job is strictly a straightening job.
2. Remove upholstery.	
3. Remove undercoating from damaged area.	NOTE: Avoid overworking the metal, as stretching in flat panels is more obvious than in curved panels and can lead to an oil can effect.
4. Cut and remove inner panel section, if necessary.	
5. Rough out and align the damaged area.	NOTE: When hot shrinking, take care not to overheat the metal.
6. Weld or shrink if necessary.	
7. Metal finish the damaged area.	. SC-1D-1 thru SC-1D-6
8. Grind the damaged area.	
9. Fill, if necessary, using solder or plastic.	
10. Replace inner panel by welding.	
11. Clean up the area.	

METHOD OF EVALUATION:

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 40 hours

JOB: Repair a 100 Square Inch Dent in a Trunk Lid

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-3

COURSE: Automotive Body and Fender

MATERIAL: 1 Bar 30/70 Body Solder or
Plastic Filler
#24 Open-Coat Disc
#50 Closed-Coat Disc
1 Piece, 1/16" or 3/32" Welding
or Brazing Rod

Soldering Paddles
Damaged Trunk Lid
Beeswax
Tinning Material
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding and
Soldering)
Dollies (Instructor's Choice)

Welding Goggles
Gloves (Optional)
Safety Goggles

TOOLS: Disc Grinder
Panel Cutter
Phillips Screwdrivers
Straight Screwdrivers
Carbon Scraper or Putty Knife
1/4" Drive Socket Set
Allen Wrench Set

Specialized Tools (Instructor's
Choice)
Slapper
Body Hammers
Body File
Body Spoons
Pick Bars

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: This job is strictly a straightening process.
2. Remove necessary parts.	
3. Cut and remove inner panel, if necessary.	CAUTION: Use extreme care when welding or brazing the inner panel so as not to distort the outer panel!
4. Remove sound-deadening material.	
5. Rough out and align damaged area.	. SC-1D-1 thru SC-1D-6
6. Weld or shrink if necessary.	
7. Metal finish the damaged area.	
8. Grind the damaged area.	
9. Replace inner panel (weld or braze).	
10. Fill weld or braze on the inner panel as necessary.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

11. Fill, if necessary, using solder or plastic.
12. Replace necessary parts.
13. Clean up the area.

METHOD OF EVALUATION:

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 40 hours

JOB: Repair a 100 Square Inch Dent
in a Hood

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-4

COURSE: Automotive Body and Fender

MATERIAL: 1 Bar 30/70 Body Solder or
Plastic Filler
1 Piece 1/16" or 3/32" Welding
or Brazing Rod
#24 Open-Coat Disc
Bucket of Water

Tinning Material
Soldering Paddles
Damaged Hood
Beeswax
#50 Closed-Coat Disc

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding and
Soldering
Dollies (Instructor's Choice)

Welding Goggles
Gloves (Optional)
Safety Goggles

TOOLS: Disc Grinder
Panel Cutter
Phillips Screwdrivers
Straight Screwdrivers
Upholstery Tools
Carbon Scraper or Putty Knife
Allen Wrench Set

Specialized Tools
(Instructor's Choice)
1/4" Drive Socket Set
Slap Hammer
Body Hammer
Body File
Body Bars

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: This job is strictly a straightening process.
2. Remove necessary parts.	
3. Cut and remove inner panel, if necessary.	CAUTION: Use extreme care when welding or brazing the inner panel so as not to distort the outer panel!
4. Remove sound-deadening material.	
5. Rough out and align damaged area.	. SC-1D-1 thru SC-1D-7
6. Weld or shrink if necessary.	
7. Metal finish the damaged area.	
8. Grind the damaged area.	
9. Replace inner panel (weld or braze).	
10. Fill by welding or brazing on the inner panel as necessary.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Fill if necessary, using solder or plastic. 12. Replace necessary parts. 13. Clean up the area.	

METHOD OF EVALUATION:

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 40 hours

JOB: Repair the Crushed Headlight Area
of a Front Fender

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-5

COURSE: Automotive Body and Fender

MATERIAL: 1 Bar 30/70 Body Solder or
Plastic Filler
Damaged Fender with Headlight
Assembly and Door
1/16" or 3/32" Welding Rod
Soldering Paddles

#50 Closed-Coat Disc
Tinning Material
Beeswax
#24 Open-Coat Disc
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding and
Soldering
Welding Goggles
Porta-Power

Gloves (Optional)
Dollies
Caulking Iron
Friction Jack
Safety Goggles

TOOLS: Disc Grinder
Forming Pliers
1/4" Drive Socket Set
Phillips Screwdrivers
Straight Screwdrivers
Body Spoons
Speed and Body Files

Slide Hammer, Heavy Duty
Fender Beating Pliers
Drip Molding Pliers
Clutch Screwdrivers
3/8" Drive Socket Set
Putty Knife or Carbon
Scraper

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Analyze the job.	NOTE: The instructor will be checking for a 3-way alignment of headlamp assembly, headlamp door and fender. . SC-1D-1 thru SC-1D-6 . SC-1D-8
2. Remove necessary parts.	
3. Remove undercoating.	
4. Rough out and align damaged area.	
5. Weld or shrink if necessary.	
6. Metal finish the damaged area.	
7. Grind the damaged area.	
8. Fill if necessary, using solder or plastic.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. If filler is used, shape to contours by filling or sanding.	
10. Replace necessary parts.	. SC-1D-9
11. Clean up the area.	

METHOD OF EVALUATION:

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 40 hours

JOB: Repair a Front Fender Using
the Stretch Method

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-6

COURSE: Automotive Body and Fender

MATERIAL: 1 Bar 30/70 Body Solder
or Plastic Filler
1/16" or 3/32" Welding Rod
#24 Open-Coat Disc
Bucket of Water

#50 Closed-Coat Disc
Tinning Material
Soldering Paddles
Beeswax
Solder Plates

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tip (Welding and
Soldering)
Welding Goggles
Gloves (Optional)
Caulking Iron

Friction Jack
Porta-Power
Safety Goggles
Blair Clamps
Dollies

TOOLS: 1/4" Drive Socket Set
Phillips Screwdrivers
Straight Screwdrivers
Clutch Screwdrivers
Slide Hammer, Heavy Duty
Body Spoons
Forming Pliers
Body Hammer

Fender Beating Pliers
Carbon Scraper or Putty Knife
3/8" Drive Socket Set
Drip Molding Pliers
Disc Grinder
Pick Bars
Body Files

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Analyze the job.	NOTE: Overheating the solder reduces the holding power of the solder plate.
2. Remove necessary parts.	
3. Remove undercoating from damaged area.	. SC-1D-10
4. Rough out and align damaged area.	
5. Weld or shrink if necessary.	
6. Metal finish the damaged area.	
7. Grind the damaged area.	
8. Tin and solder, or fill as necessary.	

9. Shape to contours by filing and sanding.
10. Replace necessary parts.
11. Clean up the area.

METHOD OF EVALUATION

1. Safety in use of tools and equipment.
2. Proper safety equipment.
3. Proper use of material--especially flammable.
4. Check to see if an over amount of filler was mixed and proper disposal of unused mixed filler.
5. Soldering process--(tinning and filling).
6. Shrinking process--(if needed).
7. Clean up area.
8. Time: 45 hours

JOB: Repair and Refinish Front Door
 UNIT I: Metal Work
 COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-7

MATERIAL: Provide Automobile with
 Damaged Door Post
 #24 Open-Coat Disc
 #50 Closed-Coat Disc
 Tinning Material
 #320 w/d Abrasive Paper
 #360 w/d Abrasive Paper
 #400 w/d Abrasive Paper
 Paint Strainers
 Hand Rubbing Compound
 Metal Conditioner
 Retarder
 1/16" or 3/32" Welding Rod
 Soldering Paddles
 Wax/Tar/Grease Remover
 Paper or Cloth Wipers

#80D Production Paper
 Liquid Polish
 Mixing Paddles
 Medium Grade Thinner
 Specialized Solvent Material
 Solder--30/70 or Plastic Filler
 Beeswax
 Sealer
 Enamel Reducer
 Tack Rag
 Steel Wool
 Color Coat
 Glazing Putty
 Bucket of Water
 Suction Cup
 Primer-Surfacer

EQUIPMENT: Oxy-acetylene Welding Equipment
 with Proper Tips (Welding
 and Soldering)
 Welding Goggles
 Gloves (Optional)
 Tape Apron Machine

Air Gun
 Dollies (Instructor's Choice)
 Soldering Equipment
 Respirator
 Safety Goggles
 Spray Gun

TOOLS: Carbon Scraper or Putty Knife
 Pick Bars
 Upholstery Tools
 Body Hammers
 Slide Hammer
 Disc Grinder
 Slapper
 3/8" and 1/4" Drive Socket Set

Body Spoons
 Allen Wrench Set
 Phillips Screwdrivers
 Straight Screwdrivers
 Speed and Body File
 Specialized Tools (Instructor's
 Choice)
 Panel Cutter

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

1. Analyze the job.
2. Remove upholstery.
3. Remove undercoating from damaged area.
4. If necessary, cut and remove inner panel section.

TEACHING/LEARNING ACTIVITIES

NOTE: Avoid overworking the metal, as stretching in flat panels is more obvious than in curved panels and can lead to an oil can effect.

NOTE: When hot shrinking, take care not to overheat the metal.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Rough out and align the damaged area.	. SC-1D-11
6. Weld or shrink if necessary.	. SC-1D-12
7. Metal finish the damaged area.	NOTE: All glass and chrome must be protected.
8. Grind the damaged area.	NOTE: Allow sufficient drying between each coat of primer-surfacer.
9. Fill if necessary, solder or plastic.	NOTE: Old color coat should be compounded and cleaned properly prior to application of new color coat.
10. Replace inner panel if removed.	NOTE: Remove masking either prior to or after buffing (instructor's choice).
11. Replace upholstery.	
12. Clean up the area.	
13. Wash area with wax/tar/grease remover.	
14. Feather edge damaged area with #800 production paper using a sanding block.	
15. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
16. Mask off areas not to be painted.	
17. Wash area with enamel reducer.	
18. Wash bare metal with metal conditioner.	
19. Mix primer-surfacer.	
20. Spray bare metal area with primer-surfacer.	
21. After primer-surfacer has dried, spot-glaze areas as needed.	
22. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
23. Spray area with primer.	
24. Repeat steps 10, 11 and 12 until area is ready for sealer, using #360 or #400 w/d abrasive paper.	
25. Prepare color coat in a separate spray gun.	
26. Wash area with enamel reducer.	

27. Blow dust off area to be painted and wipe with tack rag.
28. Apply specialized solvent and color coats as specified by the manufacturer.
29. After sufficient drying time, hand compound the area. Buff and polish the area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 8 hours

JOB: Repair and Refinish Rear Door

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Provide Automobile with
Damaged Door Post
#24 Open-Coat Disc
#50 Closed-Coat Disc
Tinning Material
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Retarder
1/16" or 3/32" Welding Rod
Soldering Paddles
Wax/Tar/Grease Remover
Paper or Cloth Wipers
Tension Plates

EQUIPMENT: Porta-Power
Oxy-acetylene Welding Equipment
with Proper Tips (Welding
and Soldering
Welding Goggles
Gloves (Optional)
Spray Gun

TOOLS: Carbon Scraper or Putty Knife
Pick Bars
Upholstery Tools
Body Hammers
Disc Grinder
Slapper
Panel Cutter
3/8" and 1/4" Drive Socket Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-8

#80 Production Paper
Liquid Polish
Mixing Paddles
Medium Grade Thinner
Specialized Solvent Material
Solder--30/70 or Plastic Filler
Beeswax
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Bucket of Water
Primer-Surfacer

Tape Apron Machine
Air Gun
Dollies (Instructor's Choice)
Soldering Equipment
Respirator
Safety Goggles

Body Spoons
Allen Wrench Set
Phillips Screwdrivers
Straight Screwdrivers
Speed and Body File
Specialized Tools (Instructor's
Choice)

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Avoid overworking the metal, as stretching in flat panels is more obvious than in curved panels and can lead to an oil can effect.
2. Remove upholstery.	
3. Remove undercoating from damaged area.	
4. Cut and remove inner panel section, if necessary.	NOTE: When hot shrinking, take care not to overheat the metal.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
5. Apply tension plates and install porta-power and apply pressure as necessary to push panel into original shape.	. SC-1D-13 thru SC-1D-15
6. Weld or shrink if necessary.	NOTE: All glass and chrome must be protected.
7. Metal finish the damaged area.	NOTE: Allow sufficient drying between each coat of primer-surfacer.
8. Grind the damaged area.	NOTE: The old color coat should be compounded and cleaned properly prior to application of a new color coat.
9. Fill using solder or plastic.	NOTE: Remove masking either prior to or after buffing (instructor's choice).
10. Replace inner panel if removed.	
11. Replace upholstery.	
12. Clean up the area.	
13. Wash area with wax/tar/grease remover.	
14. Feather edge damaged area with #80D production paper using a sanding block.	
15. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
16. Mask off areas not to be painted.	
17. Wash area with enamel reducer.	
18. Wash bare metal with metal conditioner.	
19. Mix primer-surfacer.	
20. Spray bare metal area with primer-surfacer.	
21. After primer-surfacer has dried, spot-glaze areas as needed.	
22. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
23. Spray area with primer.	
24. Repeat steps 10, 11 and 12 using #360 or #400 w/d abrasive paper, until area is ready for sealer.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

25. Prepare color coat in a separate spray gun.
26. Wash area with enamel reducer.
27. Blow dust the area to be painted and wipe with tack rag.
28. Apply specialized solvent and color coats as specified by the manufacturer.
29. After sufficient drying time, hand compound the area.
30. Buff and polish the area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Check for proper tension plate installation.
7. Check for proper porta-power head selection
8. Check proper porta-power setup.
9. Check for proper straightening technique.
10. Time: 8 hours

JOB: Repair and Refinish a Door Post

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Provide Automobile with
Damaged Door Post
#24 Open-Coat Disc
#50 Closed-Coat Disc
Soldering Faddles
Tinning Material
Wax/Tar/Grease Remover
Sealer
Primer-Surfacer
Enamel Reducer
#80D Production Paper
Medium Grade Thinner
Paint Strainers
Color Coat
Mixing Paddles
Metal Conditioner

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tip (Welding
and Soldering)
Welding Goggles
Spray Gun
Respirator
Tape Apron Machine

TOOLS: Body Spoons
Phillips Screwdrivers
Straight Screwdrivers
Body File
3/8" Drive Socket Set
Measuring Devices (Instructor's
Choice)

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-9

1/16" or 3/32" Welding Rod
Solder--30/70 or Plastic Filler
Beeswax
Paper or Cloth Wipers
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Tack Rag
Steel Wool
Liquid Polish
Hand Rubbing Compound
Glazing Putty
Retarder
Bucket of Water
Specialized Solvent Material

Welding Gloves (Optional)
Safety Goggles
Dollies (Instructor's Choice)
Porta-Power
Air Gun
Soldering Equipment

Body Hammers
Panel Cutter
Disc Grinder
Pick Bars
Putty Knife or Carbon Scraper

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	. SC-1D-14
2. Remove the upholstery.	. SC-1D-15
3. Rough out and align door post.	
4. Cut and remove inner panel section if necessary.	
5. Metal finish the damaged area and fill if needed.	
6. Replace inner panel if removed.	

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7. Wash area with wax/tar/grease remover.
8. Feather edge damaged area with #80D production paper using a sanding block.
9. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.
10. Mask off area not to be painted.
11. Wash area with enamel reducer.
12. Wash bare metal with metal conditioner.
13. Mix primer-surfacer.
14. Spray bare metal area with primer-surfacer.
15. After primer-surfacer has dried, spot-glaze areas as needed.
16. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.
17. Spray area with primer.
18. Repeat steps 15, 16 and 17 using #360 or #400 w/d abrasive paper until area is ready for sealer.
19. Compound all color coat areas on the panel.
20. Prepare specialized solvent.
21. Prepare color coat in a separate spray gun.
22. Wash area with enamel reducer.
23. Blow dust the area to be painted and wipe with tack rag.
24. Apply specialized solvent and color coats as specified by the manufacturer.
25. After sufficient drying time, hand compound the area.

26. Buff and polish the area.
27. Replace upholstery.
28. Clean up area.

METHOD OF EVALUATION:

1. Check improper hot shrinking leading to molecular breakdown.
2. Look for damage to adjacent panels, chrome, glass or trim.
3. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
4. Was the old paint properly cleaned and compounded prior to the application of the color coat?
5. Time: 6 hours

JOB: Repair and Refinish a Rocker Panel

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Damaged
Rocker Panel
#24 Open-Coat Disc
#50 Closed-Coat Disc
Beeswax
Paper or Cloth Wipers
#320 w/d Abrasive Paper
Enamel Reducer
#80D Production Paper
#400 w/d Abrasive Paper
Steel Wool
Liquid Polish
Hand Rubbing Compound
Glazing Putty
Retarder

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding
and Soldering)
Welding Goggles
Gloves (Optional)
Soldering Equipment

TOOLS: Straight Screwdriver
Phillips Screwdriver
Putty Knife
Slide Hammer
Body Hammer
Body Spoons

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-10

1/16" or 3/32" Welding Rod
Tinning Materials
30/70 Body Solder or
Plastic Filler
Wax/Tar/Grease Remover
Sealer
Primer-Surfacer
#360 w/d Abrasive Paper
Tack Rag
Medium Grade Thinner
Paint Strainers
Color Coat
Mixing Paddles
Metal Conditioner
Specialized Solvent Material

Safety Goggles
Caulking Irons
Dollies
Spray Gun
Air Gun
Respirator

Panel Cutter
Body File
Pick Bars
Slapper
Disc Grinder

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove sill plate and molding.
3. Cut and remove inner panel if needed.
4. Metal finish the damaged area and fill if needed.
5. Replace inner panel if removed.
6. Wash area with wax/tar/grease remover.
7. Feather edge damaged area with #80D production paper using a sanding block.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
9. Mask off areas not to be painted.	
10. Wash area with enamel reducer.	
11. Wash bare metal with metal conditioner.	
12. Mix primer-surfacer.	
13. Spray bare metal area with primer-surfacer.	
14. After primer-surfacer has dried, spot-glaze areas as needed.	
15. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
16. Spray area with primer.	
17. Repeat steps 14, 15 and 16 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
18. Compound all color coat areas on the panel.	
19. Prepare specialized solvent.	
20. Prepare color coat in a separate spray gun.	
21. Wash area with enamel reducer.	
22. Blow dust the area to be painted and wipe with tack rag.	
23. Apply specialized solvent and color coats as specified by the manufacturer.	
24. After sufficient drying time, hand compound the area.	
25. Buff and polish the area.	
26. Replace sill plate and moulding.	

27. Clean up area.

METHOD OF EVALUATION:

1. Check improper hot shrinking leading to molecular breakdown.
2. Look for damage to adjacent panels, chrome, glass or trim.
3. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
4. Was the old paint properly cleaned and compounded prior to the application of the color coat?
5. Time: 4 hours

JOB: Repair and Refinish a Front Fender
by Using a Patch Panel

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-11

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Damaged
Front Fender
#24 Open-Coat Ground Disc
#50 Close-Coat Grinding Disc
Spot Welding Rods
Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#400 w/d Abrasive Paper
Hand Rubbing Compound
Primer-Surfacer
Medium Grade Thinner
Mixing Paddles
Sealer
Tack Rag
Color Coat
Specialized Solvent Material

30/70 Solder or Plastic Filler
Beeswax
1/16" or 3/32" Welding or
Spelter Rod
Tinning Material
Paper or Cloth Wipers
#360 w/d Abrasive Paper
Paint Strainers
Metal Conditioner
#800 Production Paper
Liquid Polish
Retarder
Enamel Reducer
Steel Wool
Glazing Putty
Patch Panel or Sheet Metal
Pop Rivet Kit

EQUIPMENT: Oxy-Acetylene Welding Equipment
with Proper Tips (Welding
and Soldering)
Welding Goggles
Gloves (Optional)
Safety Goggles
Caulking Irons
Pull Rods

Dollies
Spot Welder
Tape Apron Machine
Spray Gun
Air Gun
Respirator
Soldering Equipment

TOOLS: Straight Screwdriver
Phillips Screwdriver
Putty Knife
Panel Cutter
Body File
Pick Bars
1/4" and 3/8" Socket Set

Body Spoons
Body Hammer
Slapper
Disc Grinder
Slide Hammer
Welding Pliers
1/4" Electric Drill with
1/8" Bit

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	. SC-1D-16
2. Clean undercoat from damaged area.	
3. Rough out and align if necessary.	
4. Remove paint from damaged area.	
5. Align and install new panel with pop rivets.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Spot weld.	
7. Grind.	
8. Fill if necessary using solder or plastic and work to contour.	
9. Wash area with wax/tar/grease remover.	
10. Feather edge damaged area with #80D production paper using a sanding block.	
11. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
12. Mask off areas not to be painted.	
13. Wash area with an enamel reducer.	
14. Wash bare metal with metal conditioner.	
15. Mix primer-surfacer.	
16. Spray bare metal area with primer-surfacer.	
17. After primer-surfacer has dried, spot-glaze areas as needed.	
18. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
19. Spray area with primer.	
20. Repeat steps 16, 17 and 18 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
21. Prepare color coat in a separate spray gun.	
22. Wash area with an enamel reducer.	
23. Blow dust the area to be painted and wipe with tack rag.	
24. Apply specialized solvent and color coats as specified by the manufacturer.	

25. After sufficient drying time, hand compound the area.
26. Buff and polish the area.
27. Clean up area.

METHOD OF EVALUATION:

1. Check improper hot shrinking leading to molecular breakdown.
2. Look for damage to adjacent panels, chrome, glass or trim.
3. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
4. Was the old paint properly cleaned and compounded prior to the application of the color coat?
5. Time: 4 to 8 hours

JOB: Repanel and Refinish a Door

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Door that
Needs Repaneling
#24 Open-Coat Disc
#50 Closed-Coat Disc
Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
1/16" or 3/32" Welding or
Spelter Rod
Paper or Cloth Wipers
Tinning Material

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding
and Soldering
Gloves (Optional)
Soldering Equipment
Air Gun
Dollies (Instructor's Choice)

TOOLS: Carbon Scraper or Putty Knife
Body Spoons
Pick Bars
Body Hammers
3/4" Drive Socket Set
Upholstery Tools
Welding Pliers
1/4" Drive Socket Set
Straight Screwdriver

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-12

Primer-Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Spot Welder Rods
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Specialized Solvent Material
Bucket of Water

Tape Apron Machine
Respirator
Welding Goggles
Safety Goggles
Reck Rack
Spray Gun
Spot Welder

Speed and Body File
Disc Grinder
Slapper
Specialized Tools
(Instructor's Choice)
Body Spoons
Panel Cutter
Allen Wrench Set
Phillips Screwdriver

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery and glass (if needed).
3. Remove door from the car.
4. Secure in reck rack.
5. Remove outer door panel by using a disc grinder.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Remove outer door panel flange.	
7. Align and fit door panel to door frame.	
8. Crimp the edge and tack weld.	
9. Install and check for body alignment.	
10. Complete welding operation.	
11. Complete metal work where needed. Fill if needed.	
12. Wash area with wax/tar/grease remover.	
13. Feather edge paint with #80D production paper using a sanding block.	
14. Sand new panel with #80D production paper.	NOTE: If surface is primed use #320 w/d abrasive paper.
15. Mask off areas not to be painted.	
16. Wash area with enamel reducer.	
17. Wash bare metal with metal conditioner.	
18. Mix primer-surfacer.	
19. Caulk flange area.	
20. Spray bare metal area with primer-surfacer.	
21. After primer-surfacer has dried, spot-glaze areas as needed.	
22. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
23. Spray area with primer.	
24. Repeat steps 20, 21 and 22 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
25. Prepare color coat in a separate spray gun.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
26. Wash area with an enamel reducer. 27. Blow dust the area to be painted and wipe with tack rag. 28. Apply color coats as specified by the manufacturer. 29. After sufficient drying time, hand compound the area. 30. Buff and polish the area. 31. Replace glass and trim. 32. Clean up area.	

METHOD OF EVALUATION:

1. Check for proper alignment prior to removal of old panel.
2. Check for proper alignment and welding of new panel.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 4 - 6 hours

JOB: Repair and Refinish a Quarter Panel

JOB SHEET

UNIT I: Repair and Refinish

IDENTIFICATION CODE

COURSE: Automotive Body and Fender

JOB NUMBER: J-1D-13

MATERIAL: Automobile with Damaged Quarter Panel
#240 Per-Coat Disc
#50 Closed-Coat Disc
Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Finishing Material
Paper or Cloth Wipers
Primer-Surfacer
#80 Production Paper
Color Coat
Specialized Solvent Material

Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Undercoating Material
Metal Conditioner
Spot Welder Rods
1/16" or 3/32" Welding or
Spelter Rod
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Glazing Putty
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tip
Tape Apron Machine
Porta-Power Set
Soldering Equipment
Gloves (Optional)
Dust Gun

Safety Goggles
Spray Gun
Welding Goggles
Dollies (Instructor's Choice)
Respirator
Air Sander

TOOLS: Slapper
Upholstery Tools
Body Spoons
Panel Cutter
Body Hammers
Carbon Scraper or Putty Knife
Speed and Body File

Socket Set, 1/4" and 3/8"
Straight Screwdriver
Phillips Screwdriver
Slide Hammer--Heavy Duty
Disc Grinder
Pick Bars
Allen Wrench Set

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery (if needed).
3. Remove undercoating from damaged area.
4. Cut and remove inner panel section,
if necessary.
5. Rough out and align the damaged area.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Weld or shrink if necessary.	
7. Metal finish the damaged area.	
8. Grind the damaged area.	
9. Fill if necessary, using solder or plastic.	
10. Replace inner panel if removed and undercoat inside of panel.	
11. Wash area with wax/tar/grease remover.	
12. Feather edge damaged area with #80D production paper using a sanding block.	
13. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
14. Mask off areas not to be painted.	
15. Wash area with enamel reducer.	
16. Wash bare metal with metal conditioner.	
17. Mix primer-surfacer.	
18. Spray bare metal area with primer-surfacer.	
19. After primer-surfacer has dried, spot-glaze areas as needed.	
20. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
21. Spray area with primer.	
22. Repeat steps 19, 20 and 21 using #360 or #400 w/d abrasive paper, until area is ready for sealer.	
23. Compound all color coat areas on the panel (if spotting).	
24. Prepare specialized solvent.	
25. Prepare color coat in a separate spray gun.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
26. Wash area with an enamel reducer.	
27. Blow dust the area to be painted and wipe with tack rag.	
28. Apply specialized solvent and color coats as specified by the manufacturer.	
29. After sufficient drying time, hand compound the area.	
30. Buff and polish the area.	
31. Clean up area.	

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 10-14 hours

JOB: Repair and Refinish a Quarter Panel
by Using a Patch Panel

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1D-14

COURSE: Automotive Body and Fender

MATERIAL: #50 Closed-Coat Disc
Soldering Paddles
Tinning Material
Wax/Tar/Grease Removed
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Undercoating Material
Sealer
Tack Rag
Steel Wool
Specialized Solvent Material
Pop Rivet Kit

1/16" or 3/32 Welding Rod
Solder--30/70 or Plastic Fill
Beeswax
Paper or Cloth Wipers
Primer-Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Patch Panel
Enamel Reducer
Color Coat
Glazing Putty
Automobile with Appropriately
Damaged Quarter Panel
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tip
Porta-Power
Dollies (Instructor's Choice)
Welding Goggles
Air Sander
Dust Gun

Gloves(Optional)
Tape Apron Machine
Soldering Equipment
Spray Gun
Respirator
Safety Goggles

TOOLS: Slapper
Socket Set 1/2", 3/8"
Upholstery Tools
Speed and Body File
Body Hammers
Pick Bars
Slide Hammer--Heavy Duty

Disc Grinder
Allen Wrench Set
Carbon Scraper or Putty Knife
Straight Screwdrivers
Phillips Screwdrivers
Body Spoons
Panel Cutter

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Analyze the job.
2. Remove upholstery. (If needed)
3. Remove undercoating from damaged area.
4. Rough out and align.
5. Shrink if necessary.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Cut out damaged area if necessary.	
7. Align the repaired patch panel and secure with pop rivets. Then tack weld or braze.	
8. Complete the welding or brazing of panel.	
9. Grind damaged area.	
10. Fill as needed.	
11. Undercoat.	
12. Replace upholstery if removed.	
13. Wash area with wax/tar/grease remover.	
14. Feather edge damaged area with #80D production paper using a sanding block.	
15. Sand 6' beyond perimeter of damaged area using #320 w/d abrasive paper.	
16. Mask off areas not to be painted.	
17. Wash area with an enamel reducer.	
18. Wash bare metal with metal conditioner.	
19. Mix primer-surfacer.	
20. Spray bare metal area with primer-surfacer.	
21. After primer-surfacer has dried, spot-glaze areas as needed.	
22. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
23. Spray area with primer.	
24. Repeat steps 19, 20 and 21 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
25. Compound all color coat areas on the panel (if spot painting).	
26. Prepare specialized solvent.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
27. Prepare color coat in a separate spray gun.	
28. Wash area with enamel reducer.	
29. Blow dust the area to be painted and wipe with tack rag.	
30. Apply specialized solvent and color coats as specified by the manufacturer.	
31. After sufficient drying time, hand compound the area.	
32. Buff and polish the area.	
33. Clean up area.	

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 3-6 hours

JOB: Repair and Refinish a Trunk Lid

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Damaged Trunk Lid
 #50 Closed-Coat Disc
 Tinning Material
 Wax/Tar/Grease Remover
 #320 w/d Abrasive Paper
 #360 w/d Abrasive Paper
 #400 w/d Abrasive Paper
 Paint Strainers
 Hand Rubbing Compound
 Metal Conditioner
 Undercoating Material
 Soldering Paddles
 Beeswax
 Paper or Cloth Wipers
 Primer-Surfacer
 #80D Production Paper

EQUIPMENT: Oxy-acetylene Welding Equipment
 with Proper Tips (Welding and
 Soldering)
 Safety Goggles
 Gloves (Optional)
 Respirator
 Tape Apron Machine

TOOLS: Pick Bars
 3/8" and 1/4" Drive Socket Set
 Carbon Scraper or Putty Knife
 Slapper
 Body Spoons
 Disc Grinder
 Specialized Tools (Instructor's
 Choice)

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-15

Medium Grade Thinner
 Liquid Polish
 Mixing Paddles
 Retarder
 Specialized Solvent Material
 #24 Open-Coat Disc
 1/16" or 3/32" Welding Rod
 Solder--30/70 or Plastic
 Filler
 Sealer
 Enamel Reducer
 Tack Rag
 Steel Wool
 Color Coat
 Glazing Putty
 Bucket of Water

Spray Gun
 Welding Goggles
 Dollies (Instructor's Choice)
 Air Sander
 Solder Equipment
 Dust Gun

Allen Wrench Set
 Phillips Screwdrivers
 Straight Screwdrivers
 Body File
 Panel Cutter
 Speed File
 Body Hammers

COMPETENCE - PROCEDURE/STEPS
 The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove necessary parts.
3. Cut and remove inner panel, if necessary.
4. Remove sound-deadening material.
5. Rough out and align damaged area.
6. Weld or shrink if necessary.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Metal finish the damaged area.	
8. Grind the damaged area.	
9. Replace inner panel by welding or brazing and then undercoat.	
10. Fill over the weld or braze and inner panel if necessary.	
11. Fill, if necessary, the outer panel with solder or plastic.	
12. Replace necessary parts.	
13. Wash area with wax/tar/grease remover.	
14. Feather edge damaged area with #80D production paper using a sanding block.	
15. Sand 6' beyond perimeter of damaged area using #320 w/d abrasive paper.	
16. Mask off areas not to be painted.	
17. Wash area with enamel reducer.	
18. Wash bare metal with metal conditioner.	
19. Mix primer-surfacer.	
20. Spray bare metal area with primer-surfacer.	
21. After primer-surfacer has dried, spot-glaze areas as needed.	
22. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
23. Spray area with primer.	
24. Repeat steps 19, 20 and 21 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
25. Compound all color coat areas on the panel (if spot painting).	
26. Prepare specialized solvent.	
27. Prepare color coat in a separate spray gun.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
28. Wash area with enamel reducer.	
29. Blow dust the area to be painted and wipe with tack rag.	
30. Apply specialized solvent and color coats as specified by the manufacturer.	
31. After sufficient drying time, hand compound the area.	
32. Buff and polish the area.	
33. Clean up area.	

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 4-8 hours

JOB:	Repair and Refinish a Lower Trunk Panel	JOB SHEET <u>IDENTIFICATION CODE</u>
UNIT I:	Metal Work	JOB NUMBER: J-1D-16
COURSE:	Automotive Body and Fender	
MATERIAL:	Automobile with Damaged Lower Trunk Panel 1 Piece, 1/16" or 3/32" Welding or Brazing Rod Tinning Material 1 Bar 30/70 Body Solder or Plastic Filler Sealer Primer-Surfacer #360 w/d Abrasive Paper Tack Rag Medium Grade Thinner Paint Strainers Color Coat Mixing Paddles Specialized Solvent Materials	#50 Closed-Coat Disc #24 Open-Coat Disc Wax/Tar/Grease Remover Paper or Cloth Wipers #320 w/d Abrasive Paper Enamel Reducer #80D Production Paper #400 w/d Abrasive Paper Steel Wool Liquid Polish Hand Rubbing Compound Glazing Putty Retarder Undercoating Materials Metal Conditioner Bucket of Water
EQUIPMENT:	Oxy-acetylene Welding Equipment with Proper Tips (Welding and Soldering) Welding Goggles Gloves (Optional) Dollies (Instructor's Choice) Porta-Power	Safety Goggles Air Gun Tape Apron Machine Air Sanders Spray Gun Respirator Soldering Equipment
TOOLS:	Carbon Scraper or Putty Knife Panel Cutter 1/4" Drive Socket Set Slide Hammer Body Hammers 1/2" Drive Socket Set	Straight Screwdrivers Phillips Screwdrivers Disc Grinder Slapper Body Spoons 3/8" Drive Socket Set

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove undercoating from the damaged area if necessary.	
3. If necessary, cut and remove inner panel.	
4. Rough out and align damaged area.	
5. Metal finish the damaged area.	

6. Replace inner panel if removed and undercoat if necessary.
7. Replace upholstery.
8. Wash area with wax/tar/grease remover.
9. Feather edge damaged area with #80D production paper using a sanding block.
10. Sand 6' beyond perimeter of damaged area using #320 w/d abrasive paper.
11. Mask off areas not to be painted.
12. Wash area with enamel reducer.
13. Wash bare metal with metal conditioner.
14. Mix primer-surfacer.
15. Spray bare metal area with primer-surfacer.
16. After primer-surfacer has dried, spot-glaze areas as needed.
17. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.
18. Spray area with primer.
19. Repeat steps 16, 17 and 18 until area is ready for sealer, using #360 or #400 w/d abrasive paper.
20. Compound all color ~~paint~~ areas on the panel (if spot painting)
21. Prepare specialized solvent.
22. Prepare color coat in a separate spray gun.
23. Wash area with enamel reducer.
24. Blow dust the area to be painted and wipe with tack rag.

25. Apply specialized solvent and color coats as specified by the manufacturer.
26. After sufficient drying time, hand compound the area.
27. Buff and polish the area.
28. Clean up area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 10 hours

JOB: Repair and Refinish a Roof

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Damaged Roof
Weatherstrip Cement
Tinning Material
1 Bar 30/70 Body Solder or
Plastic Filler
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Undercoating Materials
#50 Closed-Coat Disc
#24 Open-Coat Disc
1 Piece, 1/16" or 3/32" Welding
or Brazing Rod
Wax/Tar/Grease Remover
Bucket of Water

EQUIPMENT: Oxy-acetylene Welding Equipment
with Proper Tips (Welding and
Soldering)
Safety Goggles
Air Sanders
Dollies (Instructor's Choice)
Soldering Equipment

TOOLS: Specialized Tools (Instructor's
Choice)
Body Spoons
Upholstery Tools
Speed and Body File
Panel Cutter
1/4" Drive Socket Set
Pick Bars

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-17

Primer-Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
W/S Sealers
Body Sealer
Sealer
Enamel Reducer
Paper or Cloth Wipers
Tack Rag
Steel Wool
Color Putty
Glazing Coat
Specialized Solvent Materials
Sanding Block
Squeegee

Air Gun
Porta-Power
Tape Apron Machine
Spray Gun
Welding Goggles
Gloves (Optional)
Respirator

Disc Grinder
Slapper
Carbon Scraper or Putty Knife
Allen Wrench Set
Phillips Screwdriver
Straight Screwdriver
Body Hammers

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery.
3. Remove undercoating from damaged area.
4. Cut and remove inner panel section if necessary.
5. Rough out and align the damaged area.

6. Metal finish the damaged area.
7. Replace inner panel if removed (under-coat if needed).
8. Replace upholstery.
9. Wash area with wax/tar/grease remover.
10. Feather edge damaged area with #80D production paper using a sanding block.
11. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.
12. Mask off areas not to be painted.
13. Wash area with enamel reducer.
14. Wash bare metal with metal conditioner.
15. Mix primer-surfacer.
16. Spray bare metal area with primer-surfacer.
17. After primer-surfacer has dried, spot-glaze areas as needed.
18. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.
19. Spray area with primer.
20. Repeat steps 17, 18 and 19 using #360 or #400 w/d abrasive paper until area is ready for sealer.
21. Compound all color coat areas on the panel (if spot painting).

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
22. Prepare specialized solvent.	
23. Prepare color coat in a separate spray gun.	
24. Wash area with enamel reducer.	
25. Blow dust the area to be painted and wipe with tack rag.	
26. Apply specialized solvent and color coats as specified by the manufacturer.	
27. After sufficient drying time, hand compound the area.	
28. Buff and polish the area.	
29. Clean up area.	

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 20 to 40 hours

JOB: Repair and Refinish a Cowl

UNIT: Repair and Refinish

COURSE: Automotive Body and Fender

MATERIAL: Automobile with Damaged Cowl
#50 Closed-Coat Disc
1 Bar 30/70 Body Solder or Plastic Filler
Wax/Tar/Grease Remover
#360 w/d Abrasive Paper
Paint Strainers
Metal Conditioner
Primer-Surfacer
Medium Grade Thinner
Mixing Paddles
Sealer
Tack Rag
Color Coat
Specialized Solvent Materials
Bucket of Water
Sanding Block
Damaged Dozer

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tips (Welding and Soldering)
Welding Goggles
Gloves (Optional)
Dollies (Instructor's Choice)
Spray Gun

TOOLS: Carbon Scraper or Putty Knife
Body Spoons
Pick Bars
Upholstery Tools
Body Hammers
Panel Cutter
1/4" Drive Socket Set
Allen Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-18

Tinning Material
#24 Open-Coat Disc
1 Piece, 1/16" or 3/32"
Welding or Brazing Rod
#320 w/d Abrasive Paper
#400 w/d Abrasive Paper
Hand Rubbing Compound
Paper or Cloth Wipers
#80D Production Paper
Liquid Polish
Retarder
Enamel Reducer
Steel Wool
Glazing Putty
Undercoating Materials
Body Sealer or Caulking
Squeegee

Respirator
Safety Goggles
Porta-Power
Tape Apron Machine
Air Gun
Soldering Equipment

Straight Screwdriver
Phillips Screwdriver
Speed and Body File
Disc Grinder
Slapper
Specialized Tools (Instructor's Choice)

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery.
3. Remove undercoating from damaged area.
4. Cut and remove panel section, if necessary.
5. Rough out and align the damaged area.
6. Metal finish the damaged area.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Replace panel if removed and undercoat if needed.	
8. Replace upholstery.	
9. Wash area with wax/tar/grease remover.	
10. Feather edge damaged area with #80 production paper using a sanding block.	
11. Sand 6' beyond perimeter of damaged area using #320 w/d abrasive paper.	
12. Mask off areas not to be painted.	
13. Wash area with enamel reducer.	
14. Wash bare metal with metal conditioner.	
15. Mix primer-surfacer.	
16. Spray bare metal area with primer-surfacer.	
17. After primer-surfacer has dried, spot-glaze areas as needed.	
18. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
19. Spray area with primer.	
20. Repeat steps 17, 18 and 19 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
21. If spot painting, compound all color coat areas on the panel.	
22. Prepare specialized solvent.	
23. Prepare color coat in a separate spray gun.	
24. Wash area with enamel reducer.	
25. Blow dust the area to be painted and wipe with tack rag.	
26. Apply specialized solvent and color coats as specified by the manufacturer.	

27. After sufficient drying time, hand compound the area.
28. Buff and polish the area.
29. Clean up area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damages to adjacent panel, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 8-12 hours

JOB: Repair and Refinish a Dash Panel

UNIT I: Metal Work

COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-19

MATERIAL: Automobile with Damaged Dash Panel
#50 Closed-Coat Disc
Tinning Material
#24 Open-Coat Disc
Wax/Tar/Grease Remover
Paper Strainers
Hand Rubbing Compound
Metal Conditioner
Enamel Reducer
Steel Wool
Glazing Putty
Weatherstrip Cement
1 Bar 30/70 Body Solder
or Plastic Filler
Sanding Block
Specialized Solvent Materials
Squeegee

EQUIPMENT: Porta-Power
Tape Apron Machine
Soldering Equipment
Spray Gun
Oxy-acetylene Welding Equipment
with Proper Tips (Welding
and Soldering)

TOOLS: Speed and Body File
Slapper
Carbon Scraper or Putty Knife
Allen Wrench Set
1/4" Drive Socket Set
Slide Hammer
Body Spoons

1 Piece, 1/16" or 3/32"
Welding or Brazing Rod
Sealer
Paper or Cloth Wipers
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Primer- Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Tack Rag
Color Coat
Bucket of Water

Safety Goggles
Gloves (Optional)
Dollies (Instructor's Choice)
Air Gun
Welding Goggles

Pick Bars
Straight Screwdrivers
Phillips Screwdrivers
Body Hammers
Panel Cutter
Disc Grinder
Specialized Tools (Instructor's
Choice)

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery and accessories.
3. Rough out and align damaged area.
4. Metal finish the damaged area.
5. Replace upholstery.
6. Wash area with wax/tar/grease remover.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Feather edge damaged area with #80D production paper using a sanding block.	
8. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
9. Mask off areas not to be painted.	
10. Wash area with enamel reducer.	
11. Wash bare metal with metal conditioner.	
12. Mix primer-surfacer.	
13. Spray bare metal area with primer-surfacer.	
14. After primer-surfacer has dried, spot-glaze areas as needed.	
15. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
16. Spray area with primer.	
17. Repeat steps 14, 15 and 16 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
18. If spot painting, compound all color coat areas on the panel.	
19. Prepare specialized solvent.	
20. Prepare color coat in a separate spray gun.	
21. Wash area with enamel reducer.	
22. Blow dust the area to be painted and wipe with tack rag.	
23. Apply specialized solvent and color coats as specified by the manufacturer.	

24. After sufficient drying time, hand compound the area.
25. Buff and polish the area.
26. Clean up area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Check improper hot shrinking leading to molecular breakdown.
3. Look for damage to adjacent panels, chrome, glass or trim.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 20 hours.

JOB: Repair and Refinish a Dog Leg

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Automobile with a Damaged Dog Leg
#50 Closed-Coat Disc
1 Piece, 1/16" or 3/32" Welding or Brazing Rod
Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Tinning Material
#24 Open-Coat Disc
1 Bar 30/70 Body Solder or Plastic Filler
Sanding Block

EQUIPMENT: Oxy-acetylene Welding Equipment with Proper Tips
Safety Goggles
Welding Goggles
Gloves (Optional)
Air Sander

TOOLS: Body Hammers
Pick Bars
Straight Screwdrivers
Phillips Screwdrivers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1D-20

Paper or Cloth Wipers
Primer-Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Specialist Solvent Materials
Bucket of Water
Squeegee

Tape Apron Machine
Air Gun
Spray Gun
Soldering Equipment
Respirator

Speed and Body File
1/4" Drive Socket Set
Disc Grinder
Slide Hammer

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Rough out and align damaged area.
3. Metal finish the damaged area.
4. Wash area with wax/tar/grease remover.
5. Feather edge damaged area with #80D production paper using a sanding block.
6. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.

7. Mask off areas not to be painted.
8. Wash area with enamel reducer.
9. Wash bare metal with metal conditioner.
10. Mix primer-surfacer.
11. Spray bare metal area with primer-surfacer.
12. After primer-surfacer has dried, spot-glaze areas as needed.
13. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.
14. Spray area with primer.
15. Repeat steps, 11, 12 and 13 using #360 or #400 w/d abrasive paper until area is ready for sealer.
16. If spot painting, compound all color coat areas on the panel.
17. Prepare specialized solvent.
18. Prepare color coat in a separate spray gun.
19. Wash area with enamel reducer.
20. Blow dust the area to be painted and wipe with tack rag.
21. Apply specialized solvent and color coats as specified by the manufacturer.
22. After sufficient drying time, hand compound the area.
23. Buff and polish the area.
24. Clean up area.

METHOD OF EVALUATION:

1. Check for evidence of overworking of the metal leading to the panel being stretched out of contour or an oil can effect.
2. Look for damage to adjacent panels, chrome, glass or trim.
3. Check improper hot shrinking leading to molecular breakdown.
4. Watch student during the priming operation. Has sufficient drying time been allowed between coats?
5. Was the old paint properly cleaned and compounded prior to the application of the color coat?
6. Time: 3-5 hours

JOB: Replace and Align a Front Bumper

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Bumper
Protection Covers

EQUIPMENT: Safety Goggles
Air Gun

TOOLS: 1/2" Drive Socket Set
Phillips Screwdriver
Straight Screwdriver
3/8" Drive Socket Set
Combination Wrench Set
Rubber Mallet

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-1

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Raise the car and install safety stands.	
3. Disconnect parking lamps.	
4. Remove bolts from bumper braces at frame.	. SC-1E-1
5. Remove bumper braces and parking lamps on new bumper.	
6. Install bumper braces and parking lamps on new bumper.	
7. Bolt bumper assembly to car.	
8. Align bumper to sheet metal.	
9. Connect parking lamps.	
10. Remove safety stands and lower car.	
11. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper removal and installation of bumper.
 - A. Selection and use of tools and equipment
 - B. Removal and disassembly of bumper (procedure)
 - C. Procedure in assembly of bumper
 - D. Proper align of bumper to adjacent parts
 - E. Check if parking lamp lights
 - F. Cleaning of bumper and cleaning area
2. Check on safety precautions in installing bumper.
 - A. Safety goggles
 - B. Position of jack
 - C. Safety stand (position)
3. Time: 20 hours.

JOB: Replace and Align New Gravel Deflector

JOB SHEET

UNIT I: Metal Work

IDENTIFICATION CODE

COURSE: Automotive Body and Fender

JOB NUMBER: J-1E-2

MATERIAL: New Gravel Deflector
Protection Covers
Paint and Thinner
Sandpaper
Wax and Grease Remover
Tack Rag
Cloth Wipes
Primer-Surfacer

EQUIPMENT: Safety Goggles
Respirator
Spray Gun
Air Hose
Air Gun

TOOLS: 1/2" Drive Socket Set
3/8" Drive Socket Set
Phillips Screwdriver
Regular Screwdriver
Combination Wrench Set
Rubber Mallet

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Raise the car and install safety stands.
3. Disconnect light wires.
4. Remove bolts from bumper braces at frame. . SC-1E-1
5. Remove damaged gravel deflector.
6. Prepare and spray paint gravel deflector.
7. Install new gravel deflector and align with fender edges and grille.
8. Replace bumper and align with fender and gravel deflector.
9. Connect light wires.
10. Remove safety stands and lower car.
11. Clean up area.

METHOD OF EVALUATION:

1. Check on proper jacking and position of safety stands.
2. Check on procedure in removing bumper assembly.
3. Check on removal and painting of gravel pan.
 - A. Proper procedure in preparing gravel pan for refinishing
 - B. Mixing of paint
 - C. Application of paint
4. Check on procedure in installing gravel pan and bumper.
 - A. Align to adjacent parts
5. Check on safety precautions in installing gravel pan.
 - A. Safety goggles
 - B. Safe use of flammable materials
 - C. Proper jacking and placement of safety stands
6. Time: 3 hours

JOB: Replace and Align a New Grille

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Grille

EQUIPMENT: Safety Goggles

TOOLS: 1/2" Drive Socket Set
Phillips Screwdrivers
Combination Wrench Set
3/8" Drive Socket Set
Regular Screwdrivers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-3

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Raise the car and install safety stands.
3. Disconnect parking lamps and remove bumper if necessary.
4. Remove headlamp doors if necessary.
5. Remove grille assembly.
6. Install new grille.
7. Install headlamp doors.
8. Install bumper assembly.
9. Remove safety stands and lower car.
10. Clean up area.

METHOD OF EVALUATION:

1. Check on proper jacking and position of safety stands.
2. Check on procedure in removing and installing bumper (if necessary).
3. Check on procedure in removing and installing grille.
4. Check on correct alignment to adjacent panels.
5. Check on safety in installing grille.
 - A. Safety goggles
 - B. Safety in jacking and installing stands
6. Time: 4 hours

JOB: Replace and Align a New Headlamp Assembly

JOB SHEET

UNIT I: Metal Work

IDENTIFICATION CODE

COURSE: Automotive Body and Fender

JOB NUMBER: J-1E-4

MATERIAL: Headlamp Assembly

EQUIPMENT: Safety Goggles

TOOLS: 1/4" Drive Socket Set
Combination Wrench Set
Regular Screwdriver
Phillips Screwdriver
3/8" Drive Socket Set
Spring Removal Tool

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove the headlight door.	
3. Remove screws from retaining ring.	
4. Slide out seal beam, disconnect wires and remove seal beam.	
5. Disconnect ground wire and remove headlamp housing.	
6. Install new headlamp housing and secure ground wire.	
7. Connect wires to seal beams, place seal beams in proper position and replace retainer rings.	
8. Adjust seal beams by the horizontal and vertical adjusting screws to proper angle.	
9. Install headlight door.	
10. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper procedure in removing headlamp assembly.
 - A. Door
 - B. Wires
 - C. Housing
2. Check on proper procedure in installing headlamp assembly.
 - A. Install housing
 - B. Wires
 - C. Adjust and focus seal beams
 - D. Door
3. Check on student use of safety goggles
4. Time: 1 hour

JOB: Replace and Align New Radiator Support

JOB SHEET

UNIT 1: Metal Work

IDENTIFICATION CODE

COURSE: Automotive Body and Fender

JOB NUMBER: J-1E-5

MATERIAL: New Radiator
Steel Welding Rods
Paint and Thinner
Primer-Surfacer

Cloth Wipers
Sandpaper
Tack Rags

EQUIPMENT: Safety Goggles
Air Gun
Oxy-acetylene Welding
Outfit Complete

Welding Goggles
Welding Clamps
Spray Gun
Respirator

TOOLS: 1/2" Drive Socket Set
3/8" Drive Socket Set
Phillip Screwdrivers

Regular Screwdrivers
Combination Wrench Set
Body Hammers

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

TYPE A--

1. Analyze the job.
2. Raise the car and install safety stands.
3. Remove front bumper, grille, and gravel pan, if necessary.
4. Drain radiator.
5. Remove radiator hoses.
6. Remove radiator shroud, if necessary.
7. Unbolt and remove radiator.
8. Unbolt and remove radiator support.
9. Install new radiator support.
10. Install radiator and align.
11. Install radiator shroud.
12. Install radiator hoses.
13. Fill radiator with coolant and check for leaks.
14. Install bumper, grille and gravel pan, if removed.

15. Remove safety stands and lower car.
16. Clean up area.

TYPE B--

1. Analyze the job.
2. Raise the car, and install safety stands.
3. Remove front bumper, grille and gravel pan. (Headlamp assembly)
4. Drain radiator.
5. Remove radiator hoses.
6. Remove radiator shroud, if necessary.
7. Unbolt and remove radiator.
8. Remove radiator support by cutting spot welds.
9. Align and weld new radiator support.
10. Prepare and paint welded areas.
11. Install radiator and align.
12. Install radiator shroud.
13. Install radiator hoses.
14. Fill radiator with coolant and check for leaks.
15. Install bumper, grille, gravel pan, and headlamp assembly.
16. Remove safety stands and lower car.
17. Clean up area.

METHOD OF EVALUATION:

TYPE A--

1. Check on procedure in raising and installing safety stands.
2. Check on procedure in removing adjacent parts to support.
3. Check on procedure in draining and removing radiator.
4. Check on procedure in installing and filling of coolant.
 - A. Check for leaks
 - B. Check coolant for protection
5. Check on procedure in installing adjacent parts.
 - A. Alignment
6. Check on safety precautions in installing radiator support.
 - A. Safety goggles
 - B. Safety in installing safety stands

TYPE B--

1. Check on procedures in raising and installing safety stands.
2. Check on procedures in removing adjacent parts.
3. Check on procedure in removing and draining radiator.
4. Check on procedure in removing and installing radiator support.
 - A. Cutting out old support
 - B. Alignment of new support
 - C. Welding procedures
5. Check on preparations and painting welded spots.
 - A. Metal preparation
 - B. Mixing of paint
 - C. Application of paint
6. Check on procedure in installing adjacent parts.
 - A. Safety goggles
 - B. Safety with combustable materials
 - C. Safety in raising car
7. Time: 4 hours

JOB: Replace and Align Radiator
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: New Radiator
Antifreeze
EQUIPMENT: Safety Goggles
TOOLS: 3/8" Drive Socket Set
Regular Screwdriver Set
Phillips Screwdriver Set
Combination Wrench Set
Hose Clamp Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-6

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Drain the radiator. 3. Remove shroud, if necessary. 4. Remove hoses. 5. Remove radiator. 6. Install new radiator. 7. Install bolts and adjust radiator to proper position. 8. Replace hoses. 9. Replace shroud, if removed. 10. Fill radiator with coolant. 11. Start engine and check for leaks. 12. Clean up area.	NOTE: Be careful when installing new radiator, so you don't damage the core.

METHOD OF EVALUATION:

1. Check on proper replacement of radiator.
 - A. Removal of radiator (draining coolant, hoses)
 - B. Installation of new radiator
 1. Filling with coolant (proper amount, air blocked)
 2. Hose connectors
 3. Leaks
2. Check on safety precautions in installing radiator.
 - A. Safety goggles
 - B. Handling of coolants
3. Time: 3 hours

JOB: Replace and Align Front Fender

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1E-7

COURSE: Automotive Body and Fender

MATERIAL: New Front Fender
Cloth Wipers
Wax and Grease Remover
Tack Rag
Sandpaper
Paint and Thinner
Primer-Surfacer

EQUIPMENT: Respirator
Safety Goggles
Air Gun
Spray Gun
Air Hose

TOOLS: 3/8" Drive Socket Set
Regular Screwdriver Set
Rubber Mallet
Phillips Screwdriver Set
1/2" Drive Socker Set
1/4" Drive Socket Set

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Raise the car and install safety stands.	NOTE: Check new fender for shipping damage and repair, if necessary.
3. Remove bumper, if necessary.	
4. Remove grille, if necessary.	
5. Disconnect all wires fastened to fender.	
6. Remove damaged fender.	
7. Prepare and spray paint all edges.	
8. Transfer all good parts from old fender to new fender.	
9. Install new fender and align with door and hood.	
10. Connect all wires.	
11. Replace bumper and grille, if removed.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

12. Lower car and remove safety stands.
13. Clean up area.

METHOD OF EVALUATION:

1. Check on proper procedure in replacing fender.
2. Check on removal of all adjacent parts that are necessary.
3. Check on proper jacking and positioning of safety stands.
4. Check on removal and installation procedure of new fender and adjacent parts.
 - A. Wires
 - B. Proper alignment to adjacent parts
 - C. Preparation and refinishing of new fenders
 - D. Removal of all shipping damage
5. Check on safety precautions in installing new fender.
 - A. Safety goggles
 - B. Proper handling of flammable materials
 - C. Placement of safety stands
6. Time: 3 - 6 hours

JOB: Replace and Align Hood
UNIT I: Metal Work
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-8

MATERIAL: New Hood
Cloth Wipers
Wax and Grease Remover
Tack Rag
Sandpaper
Paint and Thinner
Primer-Surfacer

EQUIPMENT: Spray Gun
Respirator
Air Hose
Safety Goggles
Air Gun

TOOLS: 3/8" Drive Socket Set
Phillips Screwdriver Set
Regular Screwdriver
Combination Pliers
1/4" Drive Socket Set
Combination Wrench Set

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove hood from hinges.
3. Prepare and spray paint all edges and interior of new hood.
4. Transfer all good parts and sound deadener from old hood to new hood.
5. Install new hood and align with fenders, cowl and grille area.
6. Adjust hood latch.
7. Clean up area.

NOTE: Check hood for shipping damage and repair.

. SC-1E-1

METHOD OF EVALUATION:

1. Check on proper installation and alignment of hood.
 - A. Hood removal and changeover of parts
 - B. Repair shipping damage on new panel
 - C. Preparation and refinishing of hood edges
 1. Sanding and cleaning of hood
 2. Spraying procedure (mixing of paint and air pressure)
2. Check on proper installation and alignment of hood.
3. Check on safety precautions in installing new hood.
 - A. Safety goggles
 - B. Safety in using refinishing materials
4. Time: 6 hours

JOB: Replace and Align Front Door

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Door
Tack Rag
Primer-Surfacer
Wax and Grease Remover
Sandpaper
Paint and Thinner
Cloth Wipers

EQUIPMENT: Safety Goggles
Respirator
Spray Gun
Air Hose
Air Gun

TOOLS: 3/8" Drive Socket
Phillips Screwdriver Set
Combination Wrench Set
Offset Screwdriver Set
1/4" Drive Socket Set
Upholstery Tools
Regular Screwdriver Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-9

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Remove damaged front door. 3. Sand and refinish door edges and install weatherstrip from damaged door. 4. Install new door and align to front fender and rear door to quarter panel. 5. Drill holes in new door for all moldings. 6. Remove interior trim from damaged door. 7. Remove glass and interior attaching parts. 8. Install glass and interior attaching parts in the new door and align parts.	NOTE: Check new door for shipping damage and repair, if necessary.

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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

9. Install interior trim.
10. Clean up area.

METHOD OF EVALUATION:

1. Check on proper removal of damage from new door.
2. Check on proper refinishing of door edge. (Preparation and refinishing procedures)
3. Check on procedure and alignment in changing parts from damaged door.
4. Check on procedure in installation and alignment of new door.
 - A. Glass
 - B. Interior trim
 - C. Latch and regulator
 - D. Hinge
5. Check on safety precautions in replacing new door.
 - A. Safety goggles
 - B. Safety in using refinishing materials
6. Time: 4-8 hours

JOB: Replace and Align Center Door Post

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Center Post
Seam Sealer
Wax and Grease Remover
Primer-Surfacer
Sandpaper
Cloth Wipers
Welding Rods
Thinner--
Tack Rag

EQUIPMENT: Complete Oxy-acetylene Welding
Outfit
Safety Goggles
Spray Gun
Air Hose
Air Gun
Respirator

TOOLS: Hammers
Phillips Screwdrivers
Straight Screwdrivers
3/8" Drive Socket Set
Upholstery Tools
Combination Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-10

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove rear door assembly.	
3. Remove front seat, if necessary.	
4. Remove step plates (front and rear).	
5. Remove floor mats as far as necessary.	
6. Remove inner trim panel on door post if separate from post.	
7. Loosen and lay back headerlining.	
8. Remove center door post.	
9. Align and clamp new center post.	
10. Tack weld and recheck alignment.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Weld center post complete.	
12. Clean, prepare and prime welded areas, then seal seams.	
13. Install headerlining.	
14. Install floor mats.	
15. Install front seat if removed.	
16. Install step plates.	
17. Install inner trim panel on center post if removed.	
18. Install and align rear door.	
19. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper procedures in removing damaged door and adjacent parts.
 - A. Seat
 - B. Floor mats
 - C. Interior trim
 - D. Rear door
 - E. Headerlining
2. Check on proper removal and alignment of new post.
 - A. Removal of damaged post
 - B. Alignment and Welding of new post
 1. Lighting torch
 2. Penetration of weld
 3. Smoothing of weld
3. Check on preparation of new post for primer-surfacer.
4. Check on care in installing interior trim and rear door.
5. Check on safety precautions in installing door post.
 - A. Safety goggles
 - B. Safety with welding equipment
 - C. Safety with refinishing materials
6. Time: 6-10 hours

JOB: Replace and Align Rear Door

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Door
Paint and Thinner
Sandpaper
Wax and Grease Remover
Tack Rag
Primer-Surfacer
Cloth Wipers

EQUIPMENT: Safety Goggles
Spray Gun
Air Hose
Air Gun
Respirator

TOOLS: 3/8" Drive Socket Set
1/4" Drive Socket Set
Offset Screwdriver Set
Phillips Screwdriver Set
Regular Screwdriver Set
Allen Wrenches
Combination Wrench Set
Upholstery Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-11

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Check new door for shipping damage and repair, if necessary.
2. Remove damaged rear door.	
3. Sand and refinish door edges, and install weatherstrip from damaged door.	
4. Install new door and align to front door and quarter panel.	
5. Drill holes in new door for all moldings.	
6. Remove interior trim from damaged door.	
7. Remove glass and interior attaching parts.	
8. Install glass and interior attaching parts in new door and align parts.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

9. Install interior trim.
10. Clean up area.

METHOD OF EVALUATION:

1. Check on proper inspection of new door for shipping damage.
2. Check on preparing refinishing of door edges.
 - A. Cleaning and sanding of door edge
 - B. Refinishing procedure
3. Check on proper procedure in installing and changing over of interior parts and trim.
4. Check on proper alignment of door to adjacent panels.
5. Check on safety precautions in replacement and alignment of door.
 - A. Safety goggles
 - B. Safety with refinishing materials
6. Time: 4-6 hours

JOB: Replace and Align Rocker Panel

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Rocker Panel
Thinner
Primer-Surfacer
Grinding Disc
Welding Rods
Wax and Grease Remover
Tack Rag
Sandpaper
Cloth Wiper

EQUIPMENT: Oxy-acetylene Welding Outfit--Complete
Safety Goggles
Dolly
Respirator
Welding Clamps
Spray Gun
Air Gun

TOOLS: Air Chisel
Hammers
Straight Screwdrivers
Phillips Screwdrivers
Grinder

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-12

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove step plates and lay back floor mats.
3. Remove rocker panels moldings if necessary.
4. Cut and remove damaged rocker panel.
5. Align surrounding panel edges.
6. Fit, align and clamp new rocker panel into panel.
7. Tack weld and check alignment.
8. Finish welding panel.

9. Prepare and prime welded area.
10. Drill holes for rocker panel moulding, if necessary.
11. Install step plates and floor mats.
12. Clean up area.

METHOD OF EVALUATION:

1. Check on proper removal of interior trim and parts.
2. Check on proper cutting and removal of damaged rocker panel.
3. Check on proper fitting and alignment of new rocker panel.
4. Check on proper welding procedure.
 - A. Setup of welding equipment
 - B. Type of rods
 - C. Penetration of weld
 - D. Procedure in welding rocker panel
5. Check on proper preparing and refinishing of rocker panel
 - A. Sanding and cleaning
 - B. Mixing of primer-surfacer
 - C. Application procedure
6. Check on proper installation and care of interior trim and parts.
7. Check on safety precautions in replacing rocker panel.
 - A. Safety goggles
 - B. Safety with refinishing materials
 - C. Safety with oxy-acetylene welding equipment
8. Time: 2-4 hours

JOB: Replace and Align Quarter Panel

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1E-13

COURSE: Automotive Body and Fender

MATERIAL: New Panel
Undercoating
Wax and Grease Remover
Thinner
Sandpaper
Tack Rag
Grinding Disc
Welding Rods
Cloth Wipers
Primer-Surfacer
Seam Sealer

EQUIPMENT: Oxy-acetylene Welding Outfit--Complete
Air Hose
Respirator
Safety Goggles
Spray Gun
Air Gun

TOOLS: Hammers
Regular Screwdrivers
3/8" Drive Socket Set
1/4" Drive Socket Set
Grinder
Phillips Screwdrivers
1/2" Drive Socket Set
Upholstery Tools
Combination Wrench Set
Air Chisel

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove rear bumper.	
3. Remove rear sill plate.	
4. Remove light assemblies.	
5. Rough out and align damaged panel.	
6. Remove gas tank, if necessary.	
7. Remove deck lid.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Remove damaged quarter panel.	
9. Align and clamp new quarter panel into position.	
10. Tack weld and recheck alignment including deck lid.	
11. Weld quarter panel complete.	
12. Sand, clean, prepare and prime welded areas, then seal seams.	
13. Install gas tank, if removed.	
14. Spray paint all edges with color coat.	
15. Replace light assemblies and align.	
16. Replace rear sill plate.	
17. Replace deck lid and align.	
18. Replace rear bumper and align.	
19. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper procedure in removal of adjacent parts, trim and mouldings.
2. Check on proper cutting and removal of quarter panel.
3. Check on proper preparing and alignment of quarter panel.
 - A. Prepare edges
 - B. Remove all damage on new panel
 - C. Tack weld
4. Check on proper welding procedures in welding in quarter panel.
 - A. Lighting and setup of welding equipment
 - B. Selection of welding rods
 - C. Penetration and appearance of weld
5. Check on proper preparation and refinishing of quarter panel with primer-surfacer.
 - A. Cleaning and sanding of panel
 - B. Mixing of primer-surfacer
 - C. Application (air pressure, distance from work)
6. Check on proper care and installation of removed parts.
7. Check on safety precautions in installing quarter panel.
 - A. Safety goggles
 - B. Safety with refinishing materials
 - C. Safety with welding equipment
8. Time: 20-25 hours

JOB: Replace and Align Rear Bumper

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Bumper
Protective Covers

EQUIPMENT: Safety Goggles

TOOLS: 1/2" Drive Socket Set
3/8" Drive Socket Set
Phillips Screwdrivers
Regular Screwdrivers
Combination Wrench Set
Rubber Mallet

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-14

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Raise the car and install safety stands.
3. Disconnect license lamp.
4. Remove bolts from bumper braces at frame.
5. Remove bumper braces and license lamp from damaged bumper.
6. Install bumper braces and license lamp on new bumper.
7. Bolt and align new bumper to automobile.
8. Connect license lamp wire.
9. Remove safety stands and lower car.
10. Clean up area.

METHOD OF EVALUATION:

1. Check on proper jacking and placement of safety stands.
2. Check on proper removal, change over of parts and installation of bumper.
3. Check on proper alignment of bumper to adjacent parts.
4. Check on safety precautions in replacement of rear bumper.
 - A. Safety goggles
 - B. Safety in jacking up car
 - C. Safety stands
5. Time: 2-4 hours

JOB: Replace and Align Trunk Lid

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Trunk Lid
Paint and Thinner
Sandpaper
Wax and Grease Remover
Tack Rag
Primer-Surfacer
Cloth Wipers

EQUIPMENT: Safety Goggles
Spray Gun
Air Hose
Respirator

TOOLS: 3/8" Drive Socket Set
Phillips Screwdriver Set
Regular Screwdriver Set
Combination Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-15

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Check new lid for shipping damage and repair, if necessary.
2. Remove damaged trunk lid.	
3. Sand and refinish edges plus interior of lid and install weatherstrip from damaged lid.	
4. Install new trunk lid and align with the quarter panels and upper deck panel.	
5. Drill holes in new lid for all moldings.	
6. Remove all attaching parts from damaged lid.	
7. Install all attaching parts to new lid.	
8. Align latch and lock assembly.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper removal of all shipping damage.
2. Check on proper cleaning and sanding of new trunk lid.
 - A. Use of wax and grease remover
 - B. Type and grit of sandpaper
 - C. Mixing of paint
 - D. Number of coats and application procedure
3. Check on proper installation and alignment of trunk lid.
4. Check on safety precautions in installing new trunk lid.
 - A. Safety goggles
 - B. Safety with refinishing materials

JOB: Replace and Align Roof Panel

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Roof Panel
Primer-Surfacer
Wax and Grease Remover
Thinner
Cloth Wipers
Sandpaper
Welding Rods
30/70 Body Solder
Tinning Material
#24 Open-Coat Disc
450 Grinding Disc
Body Sealers
Tack Rag

EQUIPMENT: Oxy-acetylene Outfit--Complete
Safety Goggles
Dollies
Respirator
Air Gun
Spray Gun

TOOLS: Phillips Screwdrivers
Regular Screwdrivers
Body Hammers
Upholstery Tools
Disc Grinder

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-16

Spot Welder
Air Sander
Tape Apron Machine
Soldering Equipment
Air Hose

Body Files
3/8" Drive Socket Set
Glass Removal Tools
Air Chisel

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove front and rear seats.	
3. Remove floor mats.	
4. Remove windshield.	
5. Remove rear window.	
6. Remove all exterior chrome surrounding the roof panel.	
7. Remove header lining.	
8. Straighten and align roof panel braces and supports.	

NOTE: Check roof for shipping damage and repair if necessary.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. Remove old roof panel.	
10. Align, clamp and tack weld new roof panel in place.	
11. Check windshield, rear glass and doors for alignment.	
12. Finish welding roof panel.	
13. Prepare, apply and finish body solder on welded area where needed.	
14. Prepare and prime welded and soldered area.	
15. Install headerlining.	
16. Install rear window.	
17. Install windshield.	
18. Install floor mats.	
19. Install front and rear seats.	
20. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper removal and care of the following:
 - A. Seats and floor mats
 - B. Windshield and rear glass
 - C. Headerlining
2. Check on proper checking and repairing of new roof panel.
3. Check on proper alignment of inner braces.
4. Check on procedure used to remove old panel.
5. Check on procedure in new roof installation.
 - A. Alignment (glass opening, doors)
 - B. Welding procedure
6. Check on application of body solder.
 - A. Preparation of area
 - B. Application of solder
 - C. Finishing of solder
7. Check on preparation and application of primed area.
 - A. Clean, treat and sand area
 - B. Mixing of primer-surfacer
 - C. Application of primer-surfacer (number of coats, distance of gun from panel)
8. Check on proper care and installation of interior trim and glass.
9. Check on safety precautions in replacement of new roof.
 - A. Safety goggles
 - B. Safety with welding equipment
 - C. Safety with refinishing materials
10. Time: 10-24 hours

JOB: Replace and Align Dash Panel

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Dash Panel
Primer-Surfacer
Wax and Grease Remover
Tack Rag
Sandpaper
Paint Thinner
Cloth Wipers

EQUIPMENT: Oxy-acetylene Welding Outfit--Complete
Air Gun
Air Hose
Safety Goggles
Tape Apron Machine
Spot Welder
Spray Gun
Respirator

TOOLS: 3/8" Drive Socket
Phillips Screwdriver
Air Cutter with Spot Weld Breaker
Hammers
Windshield Removal Tools
1/4" Drive Socket Set
Regular Screwdriver Set
Combination Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-17

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove windshield.	
3. Remove all instrument gauges and switches.	
4. Remove clock and radio.	
5. Loosen steering column and lower.	
6. Rough out and align damaged dash.	
7. Remove damaged dash.	
8. Align and clamp new dash into position.	
9. Tack weld and recheck alignment.	
10. Weld dash panel completely.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Sand, clean, prepare and prime welded areas, then seal seams.	
12. Fasten steering column.	
13. Sand, clean, mask and prepare dash for painting.	
14. Spray dash.	
15. Install clock and radio.	
16. Install all instrument gages and switches.	
17. Install windshield.	
18. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper removal of all adjacent parts.
 - A. Windshield
 - B. Gauges and clock
 - C. Radio and trim
2. Check on procedure in removing damaged dash.
3. Check on proper alignment and welding of new dash.
4. Check on procedure in cleaning and preparing dash for painting.
 - A. Use of wax and grease removers
 - B. Sanding and treating bare metal
 - C. Mixing of primer-surfacer
 - D. Application of primer-surfacer
 - E. Application of color coat
 - F. Appearance
5. Check on proper installation and care in replacing removed trim and glass.
6. Check on safety precautions in replacing dash.
 - A. Safety goggles
 - B. Safety in welding procedure
 - C. Safety in using refinishing material
 - D. Safety and protection for interior trim
7. Time: 10-20 hours

JOB: Replace and Align Wheel Well

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Wheel Well
Undercoating
Welding Rods
Grinding Discs

EQUIPMENT: Oxy-acetylene Welding Outfit
Safety Goggles
Safety Stands
Spot Welder
Dolly

TOOLS: Upholstery Tools
Body Hammer
Disc Grinder
3/8" Drive Socket Set
Regular Screwdrivers
Allen Wrenches
Air Chisel
Phillips Screwdrivers
Putty Knife

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-18

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Raise car and install safety stands.	
3. Remove wheel.	
4. Remove exterior chrome if necessary.	
5. Remove rear seat.	
6. Remove quarter trim panel.	
7. Remove trim from trunk compartment.	
8. Cut and remove wheel well and align surrounding edges.	
9. Place and align new wheel well.	
10. Tack weld and check alignment.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Complete welding wheel well.	
12. Clean welded area and spray with undercoating.	
13. Replace interior and trunk trim.	
14. Install exterior chrome if removed.	
15. Install wheel.	
16. Remove safety stands and lower car.	
17. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper jacking and placement of safety stands.
2. Check on procedure in removing interior and exterior parts.
 - A. Seat
 - B. Trim
 - C. Chrome
 - D. Wheel
 - E. Trunk compartment interior trim
3. Check on removal of damaged wheel well and alignment of new wheel well.
4. Check on welding of wheel well.
 - A. Torch preparation
 - B. Selection of rods
 - C. Welding bead
5. Check on method of cleaning and application of undercoating.
6. Check on proper installation of removed parts.
7. Check on safety precautions in replacing wheel well.
 - A. Safety goggles
 - B. Safety with welding equipment
 - C. Safety stands
8. Time: 2-4 hours

JOB: Replace and Align Floor of the Trunk Compartment

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1E-19

COURSE: Automotive Body and Fender

MATERIAL: New Floor Trunk Panel
Grinding Disc
Welding Rods
Undercoating

EQUIPMENT: Oxy-acetylene Welding Outfit
Air Chisel
Dolly
Safety Goggles
Spot Welder
Safety Stands

TOOLS: Disc Grinder
Body Hammer
Regular Screwdrivers
1/2" Drive Socket Set
Phillips Screwdrivers
Putty Knife

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze job.	
2. Raise car and install safety stand.	
3. Remove rear bumper assembly.	
4. Remove gas tank.	
5. Remove trunk trim and chrome.	
6. Cut and remove floor trunk panel.	
7. Align and tack weld.	
8. Check all alignments and complete welding.	
9. Clean welds and undercoat.	
10. Install gas tank.	
11. Install rear bumper assembly.	
12. Install trunk trim and chrome.	

METHOD OF EVALUATION:

1. Check on proper raising and placement of safety stands.
 - A. Jack placement
 - B. Safety stand position, (height of car)
2. Check on procedures in removing of necessary parts in installing floor sheet.
 - A. Gas tank (drain gas tank and remove tank)
 - B. Bumper, trim, chrome
3. Check on procedures in cutting and removing floor sheets.
 - A. Use of air chisel
4. Check on method of cleaning, preparing and aligning floor sheets.
 - A. Undercoating and rust
 - B. Tack weld
 - C. Finish welding floor sheets
5. Check on procedures and care in installing removed parts.
6. Check on safety precautions in installing floor sheets.
 - A. Safety goggles
 - B. Safety with welding equipment
 - C. Safety in draining gas
7. Time: 4-6 hours

JOB: Replace and Align Tailgate on
Station Wagon

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1E-20

COURSE: Automotive Body and Fender

MATERIAL: New Tailgate
Cloth Wipers
Weatherstrip Adhesive
Paint and Thinner

Sandpaper
Wax and Grease Remover
Tack Rag
Primer-Surfacer

EQUIPMENT: Air Hose
Tape Apron Machine
Spray Gun

Air Gun
Safety Goggles
Respirator

TOOLS: 3/8" Drive Socket Set
1/4" Drive Socket Set
Phillips Screwdrivers
Combination Wrench Set

Offset Screwdrivers
Scratch Awl
Upholstery Tools
Regular Screwdrivers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Check new tailgate for shipping damage and repair if necessary.
2. Remove damaged tailgate.	
3. Sand and refinish door edges, and install weatherstrip from damaged tailgate.	
4. Install new tailgate and align to the quarter panels.	
5. Drill holes in new tailgate for all moldings.	
6. Remove interior trim from damaged tailgate.	
7. Remove glass and interior attaching parts.	
8. Install glass and interior attaching parts in new door and adjust parts and window.	
9. Install interior trim.	
10. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper inspection and repairing of shipping damage.
2. Check on procedures in removing and changeover of parts.
3. Check on procedures in preparation and priming of new tailgate.
 - A. Cleaning and sanding edges
 - B. Mixing of primer-surfacer, (reduction of 100%--150%)
 - C. Application of primer-surfacer, (number of coats, flash time, drying)
4. Check on procedure in installing tailgate.
 - A. Tailgate alignment
 - B. Install interior parts of tailgate
 - C. Install interior trim
5. Check on safety precautions in installing tailgate.
 - A. Safety goggles
 - B. Safety with refinishing materials
6. Time: 1-2 hours

JOB: Replace and Align Dog Leg
UNIT I: Metal Work
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1E-21

MATERIAL: New Dog Leg Panel
Thinner
Sandpaper
Cloth Wiper
Primer-Surfacer
30-70 Solder

Grinding Disc
Undercoating
Welding Rods
Plastic Filler
Wax and Grease Remover

EQUIPMENT: Oxy-acetylene Welding Outfit
Complete with Solder Tip
Safety Goggles
Tape Apron Machine
Solder Equipment
Spray Gun

Air Chisel
Respirator
Welding Clamps
Dolly
Air Gun
Air Hose

TOOLS: Phillips Screwdrivers
Hammers
Disc Grinder

Tin Shears
Body Files
Straight Screwdrivers

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove step plate and lay back floor mats.	
3. Remove rocker panel molding if necessary.	
4. Cut and remove damaged dog leg.	
5. Align surrounding panel edges.	
6. Fit, align and clamp new panel into place.	
7. Tack weld and check alignment.	
8. Finish welding panel.	
9. Clean weld, then solder or fill with plastic.	
10. Shape to contour.	
11. Prepare and prime.	
12. Drill holes for moldings if necessary.	
13. Install step plates and floor mats.	

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14. Clean up area.

METHOD OF EVALUATION:

1. Check on procedures in removing moldings and mats to install dog legs.
2. Check on procedures in cutting out old dog leg.
 - A. Air chisel
3. Check on procedures in aligning and welding dog leg.
 - A. Selection of torch, size tip and size rod
4. Check on procedures in preparing and cleaning.
5. Check on safety precautions in installing of dog leg.

JOB: Remove and Replace Kick Pads
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: New Kick Pads
EQUIPMENT: Safety Goggles
TOOLS: Phillips Screwdriver Set
Scratch Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-1

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove scuff plate.	
3. Remove screws from pad.	
4. Remove pad.	
5. Replace pad and align.	
6. Replace screws--(pad) and secure.	
7. Replace scuff plate and secure.	
8. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Check on proper alignment of pad.
3. Check on proper alignment of scuff plate.
4. Make sure all screws are secure.
5. Area clean--upholstery and work area.
6. Check on proper safety precautions of equipment use.
7. Time: 10 minutes

JOB: Remove and Replace Door Panels
 UNIT I: Metal Work
 COURSE: Automotive Body and Fender
 MATERIAL: Door Panel
 EQUIPMENT: Safety Goggles
 TOOLS: Phillips Screwdriver Set
 Upholstery Special Tools
 Standard Screwdriver Set
 Allen Wrench Set
 Scratch Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-2

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove screws from upholstery.	NOTE: Be sure to use proper size of screwdriver.
3. Remove window and door handles and arm rest.	NOTE: Be careful not to damage door panel when removing window regulator and door handles or when removing the panel itself.
4. Remove door panel.	NOTE: Always be sure that the door panel weather shield is replaced if removed.
5. Replace door panel and secure.	
6. Replace window and door handles and arm rest and secure.	NOTE: On door and window regulator handles that use a horseshoe clip be sure to secure clip in the handle so the handles can then be slipped on.
	NOTE: Be sure that handles line up the same on opposite door panels.
7. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Make sure handles are secured properly.
3. Check on proper location of door handles.
 - A. Opposite door panel
4. Panel is aligned and secured properly.
5. Is area clean?
 - A. Upholstery
 - B. Work area
6. Check on proper safety precaution in use of equipment.
7. Time: 30 minutes

JOB: Remove and Replace Headliner

UNIT 1: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Headliner
Weather Strip Cement

EQUIPMENT: Safety Goggles

TOOLS: Phillips Screwdriver
Awl-Scratch
Upholstery Special Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-3

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove garnish moldings and wind-lace.	NOTE: Be careful not to damage garnish moldings or wind-lace.
3. Remove headliner courtesy lite, clothing hanger hook and safety belts.	NOTE: If headliner has bows, be sure to check and see which holes the bows are in so they are replaced in the same holes.
4. Remove headliner and change bows where appropriate.	NOTE: Be sure headliner is centered between bows.
5. Replace headliner.	
6. Replace headliner courtesy lite, clothing hanger hook, shoulder safety belts and secure.	NOTE: Start from the center of headliner and stretch towards front and back. NOTE: Also start in the center of headliner to stretch toward the sides and take up slack or looseness. NOTE: Be careful not to miss cutting the headlining on the sides or at the courtesy-lite. NOTE: Avoid getting too much weather strip cement on upholstery since it might discolor upholstery.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

7. Replace garnish moldings and wind-lace and secure.
8. Clean up area.

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Is headliner properly stretched?
3. Make sure wind-lace, garnish, and seat or shoulder belts are secured properly.
4. Make sure proper precautions in use of safety equipment have been taken.
5. Make sure upholstery and work areas are clean.
6. Time: 2-4 hours

JOB: Disassemble and Rebuild Seats

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Binder Tape
Hog Rings
Spring Clip
Seat

EQUIPMENT: Safety Goggles
Upholstery Bench

TOOLS: Phillips Screwdriver Set
3/8" Drive Socket Set
Special Upholstery Tools
Allen Wrench Set
Scratch-Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-4

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove seat from car.	NOTE: Be careful not to tear upholstery when removing seats from the car.
3. Disassemble back from seat.	
4. Remove upholstery and cushioning from seat frame.	. SC-1F-1 NOTE: Check for breaks in seat back or cushion frame.
5. Place seat on upholstery bench.	
6. Remove damaged springs or leaves.	
7. Replace new springs or leaves and secure all loose springs.	. SC-1F-2
8. Replace cushioning, upholstery and secure.	NOTE: Make sure upholstery is stretched before securing with hog rings.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. Assemble back and seat and secure. 10. Replace seat and secure. 11. Clean-up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are springs properly secured and arranged evenly?
3. Check on proper cushioning alignment.
4. Are all screws and bolts secured?
5. Make sure proper precautions in use of safety equipment are taken.
6. Make sure upholstery and work areas are clean.
7. Time: 2-4 hours

JOB: Sew Torn Seat Cover

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Thread
Hog Rings
Torn Seat Cover

EQUIPMENT: Upholstery Bench
Safety Goggles
Sewing Machine

TOOLS: Phillips Screwdriver Set
Special Upholstery Tools
Scratch Awl
3/8" Drive Socket Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-5

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	. SC-1F-3 thru SC-1F-6
2. Remove seat from car.	
3. Disassemble seat.	NOTE: Be careful not to tear upholstery when removing or replacing seat assembly from car.
4. Remove seat cover from seat frame.	. SC-1F-1
5. Sew torn area.	NOTE: Align properly before starting to sew. NOTE: Check seat springs or leaves to see if any are broken or out of place.
6. Replace seat cover to seat frame and secure.	NOTE: Check seat frame for breaks.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
7. Assemble seat and secure.	
8. Replace seat assembly in car and secure.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are springs properly secured?
3. Check on proper cushion alignment.
4. Are all screws and bolts secured?
5. Check on sewing and stitches procedures.
 - A. Seat cover stretched
 - B. Seat cover seams are parallel
6. Check on proper use of sewing equipment.
7. Is area clean?
8. Check on proper precautions in use of safety equipment.
9. Time: 1-3 hours

JOB: Fabricate Seat Cover Insert

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Thread
Seat Cover Insert
Hog Rings
Upholstery Material

EQUIPMENT: Upholstery Bench
Safety Goggles
Sewing Machine

TOOLS: Phillips Screwdriver Set
3/8" Drive Socket Set
Special Upholstery Tools
Upholstery Shears
Scratch Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-6

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	. SC-1F-3 thru SC-1F-6
2. Remove the seat from the car.	
3. Disassemble seat.	
4. Remove seat cover from seat frame.	. SC-1F-1
5. Remove seat insert from seat cover.	NOTE: Be sure that the new insert is the same as the one to be removed. (Check print or pattern).
6. Cut new insert.	
7. Align and sew insert to seat cover.	
8. Replace seat cover to seat frame.	
9. Assemble seat and secure.	
10. Replace seat in car and secure.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are springs properly secured?
3. Check on proper cushion alignment.
4. Are all screws and bolts secured?
5. Check on sewing and stitching procedures.
 - A. Seat cover stretched
 - B. Seat cover seams are parallel
6. Check on proper use of sewing equipment.
7. Is area clean?
8. Check on proper precautions in use of safety equipment.
9. Time: 1-2 hours

JOB: Remove and Replace Floor Mats

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: New Floor Mats
Cloth Wipers
Carpet or Rubber

EQUIPMENT: Vacuum Cleaner
Safety Goggles

TOOLS: Phillips and Regular Screwdrivers
3/8" Drive Socket Set
Scratch Awl
Upholstery Tools

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-7

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove front and rear seats.	NOTE: Be careful not to damage upholstery when removing and replacing seats.
3. Remove the front seat-belt bolts.	
4. Remove sill plates.	
5. Remove kick pads.	
6. Remove center door post trim, if necessary.	
7. Remove old floor mats.	NOTE: Check to see if new floor mats are the correct size before removing the old ones.
8. Vacuum inside of car.	
9. Install and align new floor mats.	
10. Replace center door post trim, if removed.	
11. Replace kick pads and secure.	
12. Replace sill plates and secure.	
13. Replace front seat-belts and secure.	

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

14. Replace front and rear seats and secure.
15. Clean up area.

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are all screws and bolts secured?
3. Make sure rugs are stretched and secured.
4. Is area clean?
5. Check on proper precautions in use of safety equipment.
6. Time: 1/2-1 hour

JOB: Lay Out, Sew and Install New Headliner

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Headliner Material
Chalk
Thread
Adhesive Cement

EQUIPMENT: Sewing Machine and
Lay Out Table
Safety Goggles

TOOLS: Upholstery Tools
3/8" Socket Set
Upholstery Shears
Screwdriver Sets--
(Phillips and Regular)
Scratch Awl

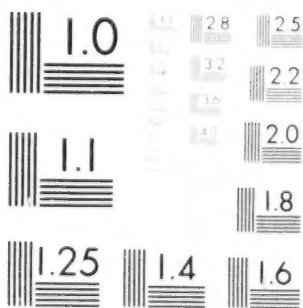
JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-8

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Be careful not to damage finish moldings or wind-lace in removal and replacement.
2. Remove headliner from car.	
3. Remove bows from headliner.	NOTE: Use measurements from the old headliner between bow inserts.
4. Lay out, cut and sew new headliner.	
5. Install bows and replace new headliner in car and secure.	NOTE: Center headliner on bows. NOTE: Start in the center of headliner to stretch toward the sides and take up slack on looseners. Exert care when cutting for the courtesy lite. Avoid getting too much weather strip cement on upholstery.
6. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Is headliner properly stretched?
3. Make sure all bolts and screws are secured.
4. Check on wind-lace, garnish mouldings on seat or shoulder belts.
 - A. Are all secured properly and aligned
 - B. Are headliner seams even and straight
5. Are the upholstery and work areas clean?
6. Check on proper precautions in use of safety equipment.
7. Time: 2-4 hours



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

JOB: Remove and Install Trunk Trim
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: New Trunk Trim
Cloth Wipers
Glue
EQUIPMENT: Safety Goggles
Vacuum Cleaner
TOOLS: Phillips and Regular Screwdrivers
Scratch Awl
1/4" Drive Socket Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-9

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove spare tire and other materials stored in the trunk.	
3. Remove floor mat.	NOTE: If mat is glued down be careful when removing.
4. Remove side upholstery panels.	
5. Clean out trunk compartment with vacuum cleaner.	
6. Install new side panels and secure.	
7. Apply new glue to trunk floor, if necessary.	
8. Install new floor mat.	
9. Install spare tire and other material removed from trunk.	
10. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are all bolts and screws secured?
3. Is spare and jack secured?
4. Is trim properly fitted?
5. Is area clean?
 - A. Upholstery
 - B. Work area
6. Check on proper precautions in use of safety equipment.
7. Time: 15 to 30 minutes

JOB: Replace Dash Padding
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: New Dash Padding
Cloth Wipers
Glue
Wax and Grease Remover
EQUIPMENT: Safety Goggles
TOOLS: Phillips Screwdrivers
Regular Screwdrivers
1/4" Drive Socket Set
Scratch Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-10

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Analyze the job.	NOTE: Alignment of rod to dash.
2. Disconnect battery terminal.	CAUTION: Be sure the battery is always disconnected when replacing dash sections.
3. Remove all moldings around padding.	
4. Remove old padding.	
5. Remove old excess glue on dash panel.	
6. Apply new glue.	
7. Install new padding and align.	
8. Replace all moldings.	
9. Connect battery terminal.	
10. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are all bolts and screws secured?
3. Was battery disconnected?
4. Check on proper alignment to panel and secured.
5. Are all instruments working?
A. Area clean (upholstery and work area)
6. Are upholstery and work areas clean?
7. Check on proper precautions in use of safety equipment.
8. Time: 2-4 hours

JOB: Remove and Replace Door Post Trim
UNIT I: Metal Work
COURSE: Automotive Body and Fender
MATERIAL: New Door Post Trim
EQUIPMENT: Safety Goggles
TOOLS: Phillips Screwdriver
Regular Screwdriver
Scratch Awl

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1F-11

<u>COMPETENCE - PROCEDURE/STEPS</u> <u>The student will be able to:</u>	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Analyze the job.	
2. Remove sill plates.	
3. Remove screws from trim.	
4. Remove trim.	CAUTION: Be careful not to damage upholstery when removing and replacing post trim.
5. Replace trim and align.	
6. Replace screws (pad) and align.	
7. Replace sill plate and secure.	
8. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper use of equipment.
2. Are all bolts and screws secured?
3. See that the door post trim is in proper alignment and secured.
4. Area clean.
 - A. Upholstery
 - B. Work area
5. Check on proper precautions in use of safety equipment.
6. Time: 30 minutes - 1 hour

JOB: Remove and Replace Front Door Glass

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-1

COURSE: Automotive Body and Fender

MATERIAL: Auto Front Door with
Broken Glass
Glass Cleaner
Rags or Paper Wipers

Adhesive
Replacement Glass
Tuff Tape
Window Channel (if needed)

EQUIPMENT: Safety Goggles

TOOLS: Upholstery Tools
Screwdrivers (Phillips and
Straight)
1/4" Drive Socket Set

Combination Wrench Set
Allen Wrench Set
Specialized Tools (Glass)

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery and accessories.
3. Remove attaching parts from window.
4. Remove window.
5. Install window.
6. Secure window with attaching parts.
7. Align and adjust.
8. Replace upholstery and accessories.
9. Clean-up area.

METHOD OF EVALUATION:

1. Check procedures in removing door glass.
 - A. Door trim
 - B. Handle and arm rest, depends on make of car
 - C. Glass attaching parts
2. Check procedures in installing glass.
 - A. Attach to regulator (check channels)
 - B. Alignment of glass
 - C. Install interior trim
 - D. Appearance and cleanliness
3. Time: 1 to 2 hours

JOB: Remove and Replace Front Door
Vent Glass

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-2

COURSE: Automotive Body and Fender

MATERIAL: Auto Front Door with Vent Glass
Replacement Vent Glass
Window Channel (if needed)
Adhesive

Tuff Tape
Glass Cleaner
Cloth or Paper Wipers

EQUIPMENT: Safety Goggles

TOOLS: Upholstery Tools
Allen Wrench Set
Specialized Tools (Glass)
Combination Wrench Set

1/4" Drive Socket Set
Screwdrivers (Phillips and
Straight)

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove upholstery and accessories (if needed).	
3. Remove attaching parts from vent window.	
4. Remove vent window.	
5. Install vent window.	
6. Secure vent window with attaching parts.	
7. Align and adjust.	
8. Replace upholstery and accessories.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check procedures in removing vent glass.
 - A. Door trim
 - B. Handle and arm rest
 - C. Glass attaching parts
2. Check procedures in installing vent glass.
 - A. Attaching parts
 - B. Alignment of glass
 - C. Install interior trim
 - D. Appearance and cleanliness
3. Time: 1-1/2 hour to 3 hours.

JOB: Remove and Replace Rear Door Glass

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-3

COURSE: Automotive Body and Fender

MATERIAL: Auto Rear Door with Broken Glass
Tuff Tape
Window Channel (if needed)
Cloth or Paper Wipers

Glass Cleaner
Adhesive
Replacement Glass

EQUIPMENT: Safety Goggles

TOOLS: Upholstery Tools
Screwdrivers (Phillips and
Straight)
1/4" Drive Socket Set

Specialized Tools (Glass)
Allen Wrench Set
Combination Wrench Set

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Analyze the job.	
2. Remove upholstery and accessories.	
3. Remove attaching parts from windows.	
4. Remove window.	
5. Install window.	
6. Secure window with attaching parts.	
7. Align and adjust.	
8. Replace upholstery and accessories.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check procedure in removing rear door glass.
 - A. Door trim
 - B. Handle and arm rest
 - C. Glass attaching parts
2. Check procedure in installing glass.
 - A. Check channels
 - B. Attach to regulator and align
 - C. Install interior trim
 - D. Appearance and cleanliness.
3. Time: 1-1/2 to 3 hours.

JOB: Remove and Replace Rear Quarter Glass

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-4

COURSE: Automotive Body and Fender

MATERIAL: 2 Door Auto with Rear
Quarter Glass
Replacement Glass
Window Channel (if needed)

Tuff Tape
Cloth or Paper Wipers
Adhesive
Glass Cleaner

EQUIPMENT: Safety Goggles

TOOLS: Upholstery Tools
Allen Wrench Set
Specialized Tools (Glass)
Combination Wrench Set

1/4" Drive Socket Set
Screwdrivers (Phillips
and Straight)

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove upholstery and accessories.	
3. Remove attaching parts from window.	
4. Remove window.	
5. Install window.	
6. Secure window with attaching parts.	
7. Align and adjust.	
8. Replace upholstery and accessories.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check procedures in removing quarter glass.
 - A. Interior trim
 - B. Handles and arm rest
 - C. Glass attaching parts
2. Check procedure used in installing glass.
 - A. Checking channels
 - B. Attaching to regulation and aligning
 - C. Install interior trim
 - D. Appearance and cleanliness
3. Time: 1 to 2 hours

JOB: Remove and Replace Quarter Window Glass
in Station Wagon

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-5

COURSE: Automotive Body and Fender

MATERIAL: Station Wagon with Broken Rear
Quarter Glass
Replacement Glass
Window Gasket (if needed)

Adhesive
Tuff Tape
Glass Cleaner
Cloth or Paper Wipers

EQUIPMENT: Safety Goggles

TOOLS: Upholstery Tools
1/4" Drive Socket Set
Allen Wrench Set

Screwdrivers (Phillips and
Straight)
Specialized Tools (Glass)
Combination Wrench Set

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove upholstery and garnish moldings.
3. Remove window.
4. Install window.
5. Replace upholstery and garnish moldings.
6. Clean up area.

METHOD OF EVALUATION:

1. Check procedures in removing station wagon quarter glass.
 - A. Interior trim
 - B. Garnish moldings
 - C. Window rubber
2. Check procedures in installing glass.
 - A. Checking window weather strip
 - B. Glass into weather strip
 - C. Chrome into weather strip (if any)
 - D. Glass into window frame (string)
 - E. Appearance and cleanliness
3. Time: 2 to 4 hours

JOB: Remove and Replace Windshield Glass

UNIT I: Metal Work

COURSE: Automotive Body and Fender

MATERIAL: Auto--With Broken Windshield
Glass
Replacement Glass (Windshield)
Windshield Sealant Kit

EQUIPMENT: Piano Wire (Instructor's Choice)
Safety Goggles
Fender Cover or Padded Cover

TOOLS: 1/4" Drive Socket Set
Screwdrivers (Phillips and
Straight)
Combination Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-1G-6

Windshield Sealer
Glass Cleaner
Cord
Cloth or Paper Wipers

Specialized Tools (Glass)
Hot Knife
Caulking Gun

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove exterior and interior moldings.	. SC-1G-7
3. Remove wiper blades and upper cowl panel.	
4. Remove windshield.	. SC-1G-2
5. Replace windshield (new).	. SC-1G-3
6. Replace interior and exterior moldings.	
7. Replace upper cowl panel and wiper blades.	
8. Clean up area.	

NOTE: Cover the dash panel
and cowl top hood with a
padded cover to avoid paint
damage and additional clean up.

METHOD OF EVALUATION:

1. Check procedures in removing windshield.
 - A. Wipers and exterior trim
 - B. Interior garnish moldings
 - C. Proper cutting of sealant with wire or hot knife
 - D. Cleaning of pinch weld
2. Check procedures in installing windshield.
 - A. Fitting and marking windshield opening
 - B. Applying sealant
 - C. Installation of glass
 - D. Replacement of removed parts
 - E. Cleaning of glass and surrounding parts
3. Time: 2 to 4 hours

JOB: Remove and Replace a Rear Window
in Sedan

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-7

COURSE: Automotive Body and Fender

MATERIAL: Sedan With a Broken Rear
Window Glass
Replacement Glass (Rear Window)
Window Sealant Kit

Glass Cleaner
Cord
Cloth or Paper Wipers
Windshield Sealer

EQUIPMENT: Fender Covers or Padded Cover
Piano Wire (Instructor's Choice)
Safety Goggles

TOOLS: 1/4" Drive Socket Set
Specialized Tools (Glass)
Hot Knife

Combination Wrench Set
Screwdrivers (Phillips and
Straight)

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

- | | |
|--|-----------|
| 1. Analyze the job. | |
| 2. Remove exterior and interior moldings. | . SC-1G-1 |
| 3. Remove rear glass. | . SC-1G-2 |
| 4. Replace rear glass (new). | . SC-1G-3 |
| 5. Replace interior and exterior moldings. | |
| 6. Clean up area. | |

NOTE: Cover the trunk lid,
quarter panels, the inside
upper deck panel and rear
seat back.

METHOD OF EVALUATION:

1. Check procedures in removing rear glass.
 - A. Exterior trim removal.
 - B. Interior garnish moldings.
 - C. Proper cutting of sealant (wire or hot knife)
 - D. Cleaning of pinch weld
2. Check procedures in installing rear glass.
 - A. Fit and mark rear glass opening
 - B. Applying sealant
 - C. Install glass
 - D. Replacement of removed parts
 - E. Cleaning of glass and surrounding parts

JOB: Remove and Replace Rear Window Glass in Station Wagon

JOB SHEET
IDENTIFICATION CODE

UNIT I: Metal Work

JOB NUMBER: J-1G-8

COURSE: Automotive Body and Fender

MATERIAL: Station Wagon with Broken Rear Window Glass
Glass Cleaner
Tuff Tape

Cloth or Paper Wipers
Replacement Glass
Adhesive (Glass)

EQUIPMENT: Safety Goggles

TOOLS: 1/4" Drive Socket Set
Combination Wrench Set
Allen Wrench Set

Screwdrivers (Phillips and Straight)
Specialized Tools (Glass)

SAFETY PRECAUTIONS:

1. Wear safety goggles.
2. Use safety in handling glass.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Remove trim cover panel and access opening covers.
3. Remove tail gate glass.
4. Replace tail gate glass.
5. Adjust and align.
6. Replace access opening covers and trim.
7. Clean up area.

METHOD OF EVALUATION:

1. Check procedures in removing rear glass.
 - A. Exterior trim removal
 - B. Interior garnish moldings
 - C. Proper cutting of sealant (wire or hot knife)
 - D. Cleaning of pinch weld
2. Check procedures in installing rear glass.
 - A. Fit and mark rear glass opening
 - B. Applying sealant
 - C. Install glass
 - D. Replacement of removed parts
 - E. Cleaning of glass and surrounding parts
3. Time: 1 to 2 hours

JOB: Prepare, Paint and Finish a Panel

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Paper or Cloth Wipers
Primer Surfacer
#80D Production Paper
Bucket of Water

EQUIPMENT Sponge
Safety Goggles
Dust Gun
Sanding Block

TOOLS: Buffer

SAFETY PRECAUTIONS:

1. Safety goggles
2. Proper use of flammable materials
3. Proper use of respirator

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-1

Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Lamb's Wool Pad

Spray Gun
Respirator
Squeegee
Masking Tape/Paper Dispenser

COMPETENCE - PROCEDURE/STEPS The student will be able to:		TEACHING/LEARNING ACTIVITIES
1. Analyze the job.		
2. Wash area with wax/tar/grease remover.		. SC-2-1
3. Feather edge damaged area with #80D production paper using a sanding block.		. SC-2-2
4. Sand entire panel with #320 w/d abrasive paper using sanding block.		
5. Mask off areas not to be painted.		. SC-2-3
		NOTE: All glass and chrome must be protected.
6. Wash area to be painted with enamel reducer.		
7. Condition bare metal with metal conditioner.		. SC-2-4
8. Mix primer-surfacer.		. SC-2-5

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. Spray bare metal area with primer-surfacer.	NOTE: Allow sufficient drying time between each coat of primer-surfacer. . SC-2-6
10. After primer-surfacer has dried, spot-glaze areas as needed.	NOTE: Allow sufficient drying time between coats to prevent cracking and splitting.
11. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
12. Spray area with primer-surfacer.	
13. Repeat steps 10, 11 and 12 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
14. Prepare sealer for spraying.	
15. Wash area with enamel reducer.	
16. Blow dust the area to be painted and wipe with tack rag prior to applying sealer.	NOTE: Allow sealer to dry as specified by the manufacturer.
17. Prepare color coat for spraying.	. SC-2-7
18. Blow dust the area to be painted and wipe with tack rag.	
19. Apply color coat as specified by the manufacturer.	. SC-2-8
20. After overnight drying, hand compound the area.	. SC-2-9
21. Buff and polish the area.	

METHOD OF EVALUATION:

1. Check proper cleaning and preparation of area for refinishing.
 - A. Cleaning with wax/grease/tar remover
 - B. Feather edge of damaged area
 - C. Sanding of panel
2. Check proper masking of surrounding areas.
 - A. Selection of tape and paper
 - B. Area masked
3. Check proper treating of metal with metal conditioner.
4. Check proper mixing and application of primer-surfacer.
 - A. Thinning and mixing of primer-surfacer
 - B. Number of coats and flash time between coats
 - C. Applying and sanding glazing putty
5. Check proper mixing and application of finish coat.
 - A. Mixing of finish coat
 - B. Application procedure of finish coat
 - C. Application procedure of specialized solvent
6. Check proper buffing and polishing of area (general appearance).
7. Check cleanup of area.

JOB: Prepare and Spot-Paint a Panel

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Primer-Surfacer
Paper or Cloth Wipers
#80D Production Paper
Bucket of Water
Lamb's Wool Pad

EQUIPMENT: Sanding Block
Buffer
Sponge
Safety Goggles
Respirator

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-2

Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Specialized Solvent Material

Dust Gun
Masking Tape/Paper Dispenser
Squeegee
Spray Gun

SAFETY PRECAUTIONS:

1. Safety goggles
2. Proper use of flammable materials
3. Proper use of respirators

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	SC-2-1 thru SC-2-9
2. Wash area with wax/tar/grease remover.	
3. Feather edge damaged area with #80D production paper using a sanding block.	
4. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
5. Mask off areas not to be painted.	NOTE: All glass and chrome must be protected.
6. Wash area with enamel reducer.	
7. Condition bare metal with metal conditioner.	
8. Mix primer-surfacer.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. Spray and build up bare metal area with primer-surfacer to the level of the painted surface.	NOTE: Allow sufficient drying between each coat of primer-surfacer.
10. After primer-surfacer has dried, spot-glaze areas as needed.	
11. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
12. Spray area with primer.	
13. Repeat steps 10, 11 and 12 using #360 or #400 w/d abrasive paper until area is ready for sealer.	NOTE: Old color coat should be compounded and cleaned properly prior to application of new color coat.
14. Compound all color coat areas on the panel.	
15. Prepare specialized solvent.	
16. Prepare color coat in a separate spray gun.	
17. Wash area with enamel reducer.	NOTE: Remove masking either prior to or after buffing (instructor's choice).
18. Blow dust the area to be painted and wipe with tack rag.	
19. Apply specialized solvent and color coats as specified by the manufacturer.	
20. After sufficient drying time, hand compound the area.	
21. Buff and polish the area.	
22. Clean-up the area.	

METHOD OF EVALUATION:

1. Check on proper cleaning and preparation of area for refinishing.
 - A. Cleaning with wax/grease/tar remover
 - B. Feather edge of damaged area (distance and grit of sand paper)
 - C. Finish sanding
2. Check on proper masking of surrounding area.
 - A. Selection of tape and paper
 - B. Distance of area masked
3. Check on proper treating of metal with metal conditioner.
4. Check on proper mixing and application of primer-surfacer.
 - A. Thinning and mixing of primer-surfacer
 - B. Number of coats and flash time between coats
 - C. Applying and sanding glazing putty
5. Check on proper compounding of surrounding areas.
6. Check on proper mixing and application of finish coat.
 - A. Mixing of finish coat
 - B. Application procedure of finish coat (number of coats, gun distance)
 - C. Application procedure of specialized solvent
7. Check on proper buffing and polishing of area (general appearance).
8. Check on proper cleanup of tools and equipment.
9. Time:

JOB: Prepare and Paint a Panel

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Tack Rag
Steel Wool
Color Coat
Bucket of Water

EQUIPMENT: Sanding Block
Squeegee
Sponge
Spray Gun

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-3

Paper or Cloth Wipers
Primer-Surfacer
#80D Production Paper
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Enamel Reducer
Glazing Putty
Lamb's Wool Pad

Dust Gun
Buffer
Masking Tape/Paper Dispenser
Safety Goggles

SAFETY PRECAUTIONS:

1. Safety goggles
2. Proper use of flammable materials
3. Proper use of respirators

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	SC-2-1 thru SC-2-10
2. Wash area with wax/tar/grease remover.	
3. Feather edge damaged area with #80D production paper using a sanding block.	
4. Sand 6" beyond perimeter of damaged area using #320 w/d abrasive paper.	
5. Mask off area not to be painted.	NOTE: All glass and chrome must be protected.
6. Wash area with enamel reducer.	
7. Wash bare metal with metal conditioner.	
8. Mix primer-surfacer.	
9. Spray and build up bare metal area with primer-surfacer to level of painted surface.	NOTE: Allow sufficient drying between each coat of primer-surfacer.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. After primer-surfacer has dried, spot-glaze areas as needed.	
11. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
12. Spray area with primer.	
13. Repeat steps 10, 11 and 12 using #320 or #360 w/d abrasive paper until area is ready for sealer.	
14. Sand all color coat areas on the panel.	NOTE: Old color coat should be sanded and cleaned properly prior to application of new color coat.
15. Prepare specialized solvent.	
16. Prepare color coat in a separate spray gun.	
17. Wash area with enamel reducer.	
18. Blow dust the area to be painted and wipe with tack rag.	
19. Apply specialized solvent and color coats as specified by the manufacturer.	
20. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper cleaning and preparation of area for refinishing.
 - A. Cleaning with wax and grease remover
 - B. Featheredging of damaged area
 - C. Finish sanding
2. Check on proper masking of surrounding areas.
 - A. Selection of tape and masking paper
 - B. Distance of areas masked
3. Check on proper treating of metal with metal conditioner.
4. Check on proper mixing and application of primer-surfacer.
 - A. Thinning and mixing of primer-surfacer
 - B. Number of coats and flash time between coats
 - C. Applying and sanding of primer-surfacer and putty
5. Check on proper mixing and application of finish coat.
 - A. Mixing of finish coat
 - B. Application procedure of finish coats (number of coats, gun distance)
 - C. Application procedure of specialized solvent
6. Check on proper buffing and polishing of area (general appearance).
7. Check on proper cleanup of tools and equipment.
8. Time:

JOB: Clean Car Interior
UNIT II: Spray Painting
COURSE: Automotive Body and Fender
MATERIAL: Cleaner
Water
EQUIPMENT: Vacuum Cleaner
Bucket
Sponges
TOOLS: Wrenches as Needed for Back
Seat Removal

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-4

Scrub Brush
Safety Goggles
Wipers (Cloth or Paper)

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Vacuum entire interior of the car.	
2. Remove rear seat.	
3. Scrub headliner with appropriate cleaner as per manufacturer's instructions.	
4. Sponge headliner clean with damp sponge.	
5. Scrub door panels with appropriate cleaner.	
6. Sponge door panels clean with damp sponge.	
7. Scrub seats with appropriate cleaner, including removed rear seat.	
8. Sponge seats clean.	
9. Scrub carpeting, if any, with scrub brush and rug shampoo.	NOTE: If there is no carpeting, remove rubber mats if possible and scrub with appropriate cleaner, sponge clean and allow to dry.
10. Remove and scrub the seat belts.	
11. Allow entire interior to dry, then replace the rear seat and seat belts.	
12. Clean all glass surfaces with window cleaner.	
13. Go over the entire interior again with the vacuum cleaner.	

METHOD OF EVALUATION:

1. Check on proper mixture of detergents.
2. Check on damp sponging immediately after scrubbing.
3. Check on proper scrubbing motion to avert tearing material.
4. Check on proper installation of all material removed.
5. Check on proper vacuuming of interior.
6. Check on clean glass.
7. Check on proper clean-up of tools.
8. Check on proper safety precautions used.
9. Time: 25 minutes

JOB: Wash a Car

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Cleaner
Water

EQUIPMENT: Water Hose
Brush
Safety Goggles
Chamois

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-5

Automobile

Steel Wool
Wipers--Cloth or Paper
Sponge

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Park the car inside or in the shade.	NOTE: Allow body metal to cool before washing.
2. Close all windows and doors tightly.	
3. Rinse the entire car with water under pressure, including underneath the fenders to remove loose dirt and dust.	
4. Mix the detergent concentrate with water as per manufacturer's instructions.	
5. Remove the hose nozzle, and using the sponge with the detergent, wash a section at a time, beginning with the roof, then rinse each section when finished washing.	
6. Rinse the entire car when through sponging with detergent, starting again with the roof and moving to the lower sections of the car.	
7. Clean the wheels, using a brush if necessary.	
8. Clean the whitewall tires, using white wall tire cleaner and steel wool.	
9. Rinse off wheels and tires.	
10. Use a chamois to thoroughly wipe off the entire car, wringing out the chamois often to keep it fairly dry.	
11. Clean all glass surfaces with window cleaner.	

METHOD OF EVALUATION:

1. Check on proper preparation of metal.
 - A. Car parked in shade or inside
 - B. Metal cool
2. Check on proper mixture of detergent.
3. Check on washing from top to bottom.
4. Check on removal of detergent immediately.
5. Check on proper cleaning of wheels and tires.
6. Check on correct use of chamois.
7. Check on clean glass.
8. Check on automobile free of dirt, streaks and sun spotting.
9. Check on proper clean up of tools and area.
10. Check on proper use of safety precautions.
11. Time: 90 minutes

JOB: Polish and Wax a Car
UNIT II: Spray Painting
COURSE: Automotive Body and Fender
MATERIAL: Polish Sealer
Polish Cleaner
EQUIPMENT: Electric Buffer
Wiping Cloths
Polish-Cleaner Brush
Safety Goggles

JOB SHEET
IDENTIFICATION CODE
JOB NUMBER: J-2-6

SAFETY PRECAUTIONS:

1. Type of clothing
2. Safety goggles

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply polish/cleaner to a 2' square area with the brush.	
2. Buff right away with an electric buffer to a high luster by holding the buffer level with a firm, well-balanced stance so that about one-third of the pad is in contact with the panel.	
3. Buff areas by hand which cannot be done with the electric buffer, making sure to rub sufficiently hard to do the job properly.	
4. Apply a sealer/wax according to manufacturer's instructions, by hand, to one panel at a time.	
5. Again following manufacturer's instructions, wipe over the waxed area.	
6. Continue with the waxing operation until the panel is finished.	
7. Apply chrome cleaner as recommended by manufacturer, if necessary.	

METHOD OF EVALUATION:

1. Check on proper application of wax.
2. Check on proper angle and handling of electric buffer.
3. Check to see if buffer burned through the paint.
4. Check on cleaning of buffer pad to avert swirl marks in finish.
5. Check on removal of wax by manufacturer's specification.
6. Check on chrome clean and polished.
7. Check on proper clean up of tools.
8. Time: 23 minutes

JOB: Recondition a Used Car
UNIT II: Spray Painting
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-7

MATERIAL: Upholstery Cleaner
Wax/Tar/Grease Remover
Degreasing Solvent
Touch-up Paint
Spatter Finish
Chrome Cleaner
Polish Rags and Wipers
Bucket of Water

Detergent Concentrate
Rubbing Compound
Window Cleaner
Flocking
Polish
Cloth Dye
Masking Tape

EQUIPMENT: Engine Cleaning Equipment (Steam
Jenny, Pressurized Spray Tank,
Spray Gun, Siphon Gun with
Extended Nozzle)
Pressurized Water Nozzle
Safety Goggles
Touch-Up Brush

Vacuum Cleaner
Masking Tape/Paper Dispenser
Buffer
Water Hose
Air Gun
Sponge

TOOLS: Wire Brush

Scrub Brush

SAFETY PRECAUTIONS:

1. Safety goggles
2. Safety with cleaning materials
3. Proper use of respirator

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Clean and recondition engine and engine compartment.	. SC-2-11
2. Clean and recondition hood and trunk compartment.	
3. Clean and recondition interior.	. SC-2-12
4. Clean and recondition exterior.	
5. Touch up exterior finish as needed.	

METHOD OF EVALUATION:

1. Check on proper cleaning of engine compartment.
 - A. Mixing of cleaning solvent
 - B. Hose down and wipe engine compartment
 - C. Spray with clear finish
2. Check on proper cleaning of trunk.
 - A. Wash and clean
 - B. Spray paint trunk
 - C. Wash and install mat
3. Check on proper cleaning of interior.
 - A. Shampoo seats and door trim (mixing of solvent and technique of shampoo)
 - B. Clean and wipe dash and mats
 - C. Interior window cleaning
4. Clean on proper cleaning of exterior.
 - A. Washing technique
 - B. Type of polish and wax
 - C. Chrome
 - D. Mixing and touch up of paint
5. Time:

JOB: Recondition Vinyl and Top Materials

JOB SHEET
IDENTIFICATION CODE

UNIT II: Spray Painting

JOB NUMBER: J-2-8

COURSE: Automotive Body and Fender

MATERIAL: Detergent
Solvent Cleaner Reconditioner
Reconditioner Thinner

Masking Tape and Paper
Rags
Tack Rag

EQUIPMENT: Spray Gun
Air Gun

Safety Goggles
Respirator

TOOLS: Brush

SAFETY PRECAUTIONS:

1. Respirator must be worn.
2. Safety goggles.
3. Proper use of flammable materials and clean up.

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Wash top thoroughly, using an appropriate detergent solution.	
2. Rinse top thoroughly and wipe dry.	
3. Clean top completely with a suitable solvent cleaner.	
4. Mask off areas which are not to be covered.	
5. Dust off with air gun.	
6. Tack area with tack rag.	
7. Thin reconditioner as per manufacturer's instructions.	
8. Spray two wet coats on the top, allowing them to flash.	
9. Spray a misting coat immediately after the second coat of color has flashed allowing the mist coat to dry at least 30 minutes.	

METHOD OF EVALUATION:

1. Check on area to be reconditioned, thoroughly clean.
2. Check on proper covering of areas not to be reconditioned.
3. Check on proper use of tack rag.
4. Check on proper preparation of reconditioner.
5. Check on application of reconditioner.
6. Check on proper clean up of tools.
7. Time: 140 minutes

JOB: Refinish Vehicle in Enamel

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
#80D Production Paper
#320, #360, #400 w/d Abrasive Paper
Paint Strainers
Metal Conditioners
Paper or Cloth Wipers
Primer-Surfacer
Medium Grade Thinner
Sponge

EQUIPMENT: Air Sanders
Spray Gun
Sanding Block
Air Gun
Squeegee

TOOLS: Combination Wrench Set
Allen Wrench Set
1/2" Drive Socket Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-9

Mixing Paddles
Sealers (Optional)
Enamel Reducer
Tack Rags
Steel Wool
Color Coat
Glazing Putty
Specialized Solvent Control
Bucket of Water

Safety Goggles
Respirator
Air Hose

1/4" Drive Socket Set
Screwdrivers (Phillips and
Straight)
Masking Tape/Paper Dispenser

SAFETY PRECAUTIONS:

1. Safety goggles
2. Flammable liquids closed properly
3. Metal Conditioner
4. Equipment
5. Respirator

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze job.
2. Remove necessary chrome trim from car.
3. Wash car with wax/tar/grease remover.
4. Complete featheredging operations using #80D production paper.
5. Complete sanding operation with proper abrasive paper.
6. Mask off areas not to be painted.
7. Wash area with enamel reducer.
8. Condition bare metal with metal conditioner.

NOTE: All metal work completed.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
9. Mix primer-surfacer, and apply sufficient coats to build bare metal area up to level of painted surface.	NOTE: Give sufficient drying time between coats to prevent splitting.
10. After primer-surfacer has dried, spot glaze areas as needed.	
11. After putty is dry, block sand with proper w/d abrasive paper.	
12. Spray area with primer-surfacer.	
13. Repeat steps 11, 12, and 13 using proper w/d abrasive paper until area is ready for sealer.	
14. Prepare sealer for spraying.	
15. Wash car with enamel reducer.	
16. Blow down, tack wipe, and apply sealer.	
17. Prepare color coat for spraying (adhere to manufacturer specifications).	
18. Blow down and tack car.	
19. Apply color coat as specified by the manufacturer.	
20. After sufficient drying time remove masking, install chrome and clean up car.	
21. Clean up area.	

METHOD OF EVALUATION:

1. Make sure all metal work is completed and necessary chrome removed.
2. Check on proper cleaning of area to be sanded.
3. Make sure vehicle is sanded with proper abrasive paper.
4. Check on proper use of sanders.
5. Make sure vehicle is masked properly.
6. Check on proper treatment of bare metal areas.
 - A. Metal conditioner
 - B. Sufficient coats of primer
 - C. Drying time between coats
 - D. Spot glazing of areas
 - E. Block sanding of glazing
7. Wipe down with enamel reducer.
8. Blow down and tack wipe.
9. Check on sealer preparation and application.
10. Check on proper thinning of color coat.
11. Correct time allowed between sealer coat and color coat.
12. Check on proper use of spraying equipment.
13. Check on proper clean up of car and chrome after sufficient drying.
14. Time: 10 to 18 hours

JOB: Refinish Vehicle in Lacquer

JOB SHEET
IDENTIFICATION CODE

UNIT II: Spray Painting

JOB NUMBER: J-2-10

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Stainers
Hand Rubbing Compound
Metal Conditioner
Paper or Cloth Wipers
Primer-Surfacer
#80D Production Paper
Bucket of Water
Lamb's Wool Pad

Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Specialized Solvent Material

EQUIPMENT: Sanding Block
Spray Gun
Buffer
Safety Goggles
Masking Tape/Paper Dispenser

Air Sanders
Air Gun
Squeegee
Respirator
Air Hose

TOOLS: 1/2" Drive Socket Set
Screwdrivers (Phillips and Straight)
Allen Wrench Set

Specialized Tools
Combination Wrench Set
1/4" Drive Socket Set

SAFETY PRECAUTIONS:

1. Safety goggles
2. Metal conditioner
3. Flammable liquids closed properly
4. Respirator

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze job.	NOTE: All metal work completed.
2. Remove necessary trim from car (chrome).	
3. Wash car with wax/tar/grease remover.	
4. Complete feather edging operations using #80D production paper.	
5. Complete sanding operation with proper abrasive paper.	
6. Mask off areas not to be painted.	
7. Wash area with enamel reducer.	
8. Condition bare metal with metal conditioner.	

METHOD OF EVALUATION:

1. Check on all metal work completed and necessary chrome removed.
2. Check on proper cleaning of area to be sanded
3. Make sure vehicle is sanded with proper abrasive paper.
4. Check on proper use of sanding equipment.
5. Make sure vehicle is masked correctly.
6. Check on proper treatment of bare metal areas.
 - A. Metal conditioner
 - B. Sufficient coats of primer
 - C. Drying time between coats
 - D. Spot glazing of areas
 - E. Block sanding of glazing
7. Wipe down with enamel reducer.
8. Blow down and tack wipe (proper cleaning).
9. Proper sealer preparation and application.
10. Proper thinning of color coat.
11. Correct time allowed between sealer coat and color coat.
12. Proper use of spray equipment.
13. Proper use of buffer and hand compounding.
14. Proper polishing of car and chrome after sufficient compounding.
15. Time: 20 to 30 hours

JOB: Spray Imitation Vinyl Top

UNIT II: Spray Painting

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
Metal Conditioners
Enamel Reducer
Primer-Surfacer
Steel Wool

EQUIPMENT: Spray Gun
Masking Tape/Paper Dispenser
Air Sanders
Rubber Gloves

TOOLS: Shop Knife

SAFETY PRECAUTIONS:

1. Safety goggles
2. Flammable liquids closed properly
3. Metal conditioner
4. Rubber gloves
5. Respirator

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-11

Medium Grade Lacquer Thinner
Sandpaper--#220 w/d Abrasive
Paper
Texture Vinyl Finish Kit
Paper and Cloth Wipers

Respirator
Air Gun
Safety Goggles
Air Hose

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Wash car with wax/tar/grease remover.	
3. Sand area to be painted with 220 w/o dry paper.	
4. Condition bare metal with metal conditioner.	
5. Spot prime, feather edged area.	
6. Sand primer-surfacer area.	
7. Wash with enamel reducer.	
8. Mask areas not to be sprayed.	
9. Blowdown, tack wipe and apply texture vinyl finish.	
10. After sufficient drying time, remove masking and clean up car.	

METHOD OF EVALUATION:

1. Check on proper cleaning of area to be sanded.
2. Make sure vehicle is sanded with proper abrasive paper.
3. Check on proper use of sanders.
4. Make sure vehicle is masked properly.
5. Check on proper treatment of bare metal areas.
 - A. Metal conditioner
 - B. Sufficient coats of primer
 - C. Drying time between coats
6. Wipe down with enamel reducer.
7. Blow down and tack rag.
8. Proper reduction of vinyl material (if necessary).
9. Correct time allowed between coats.
10. Proper use of spray equipment and clean up.
11. Check on proper clean up of car and chrome after sufficient drying time.
12. Time: 1 1/2 to 3 hours.

JOB: Dye Convertible Top

JOB SHEET
IDENTIFICATION CODE

UNIT II: Spray Painting

JOB NUMBER: J-2-12

COURSE: Automotive Body and Fender

MATERIAL: Dye
Thinner (Manufacturer Specified)
Paper or Cloth Wipers

Reducer
Upholstery Cleaner
or Detergent

EQUIPMENT: Air Gun
Spray Gun
Masking Tape/Paper Dispenser

Respirator
Safety Goggles
Air Hose

TOOLS: Upholstery or Nylon Bristle Brush

SAFETY PRECAUTIONS:

1. Safety goggles
2. Dye
3. Equipment
4. Respirator

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Scrub top one day prior to dyeing.
3. Mask off areas not to be sprayed.
4. Blow down.
5. Apply dye as manufacturer specification on application and reduction.
6. After sufficient drying time, remove masking and clean up car.

METHOD OF EVALUATION:

1. Check on proper cleaning of top.
2. Make sure vehicle is masked properly.
3. Blow down and wipe off top.
4. Check on proper preparation and thinning of dye.
5. Check on proper application of dye.
6. Check on proper use of equipment.
7. Check on proper clean up of car after sufficient drying.
8. Time: 1 to 2 hours

JOB: Refinish Interior (Spray)
UNIT II: Spray Painting
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-13

MATERIAL: Wax/Tar/Grease Remover
#320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Enamel Reducer
Tack Rag
Glazing Putty

Paper or Cloth Wipers
Primer-Surfacer
Medium Grade Thinner
Liquid Polish
Mixing Paddles
Retarder
Sealer
Steel Wool
Color Coat
Specialized Solvent Material

EQUIPMENT: Squeegee
Spray Gun
Masking Tape/Paper Dispenser
Safety Goggles

Sponge
Air Gun
Respirator
Air Hose

TOOLS: Allen Wrench Set
Screwdrivers (Phillips and
Straight)

SAFETY PRECAUTIONS:

1. Safety goggles
2. Flammable liquids closed properly
3. Respirator

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: All glass and chrome must be protected.
2. Wash areas with wax/tar/grease remover.	
3. Sand panel with wet/dry sandpaper.	
4. Mask off areas not to be painted.	
5. Wash areas to be painted with enamel reducer.	
6. Wash bare metal with metal conditioner.	
7. Mix primer-surfacer.	
8. Spray bare metal area with enough primer-surfacer to sufficiently build up bare metal area level with painted surface.	NOTE: Allow sufficient drying time between each coat of primer-surfacer.
9. After primer-surfacer has dried, spot-glaze areas as needed.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. After glazing putty is dry, block sand with #320 w/d abrasive paper and water.	
11. Spray area with primer.	
12. Repeat steps 11, 12 and 13 using #360 or #400 w/d abrasive paper until area is ready for sealer.	
13. Prepare specialized solvent.	
14. Prepare color coat in a separate spray gun.	
15. Wash area with enamel reducer.	
16. Blow dust the area to be painted and wipe with tack rag.	
17. Apply specialized solvent and color coats as specified by the manufacturer.	
18. Allow sufficient drying time then hand compound the area.	
19. Clean up area.	

METHOD OF EVALUATION:

1. Check on proper cleaning of area to be sanded.
2. Make sure job is sanded with proper abrasive paper.
3. Interior was masked properly.
4. Check on proper treatment of bare metal areas.
5.
 - A. Metal conditioner
 - B. Sufficient coats of primer
 - C. Drying time between coats
5. Wipe down with enamel reducer.
6. Blow down and tack wipe.
7. Check on proper thinning of color coat.
8. Check on proper use of spray equipment.
9. Check on compounding finish after sufficient drying.
10. Check on proper polishing of interior and chrome after compounding.
11. Time: 4 to 6 hours.

JOB: Refinish Wheels
UNIT II: Spray Painting
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-14

MATERIAL: #320 w/d Abrasive Paper
#360 w/d Abrasive Paper
#400 w/d Abrasive Paper
Paint Strainers
Hand Rubbing Compound
Metal Conditioner
Specialized Solvent Materials
Paper or Cloth Wipers
Primer-Surfacer
#80D Production Paper
Bucket of Water

Medium Grade Thinner
Liquid Polish
Mixing Paddles
Sealer
Enamel Reducer
Tack Rag
Steel Wool
Color Coat
Glazing Putty
Wax/Tar/Grease Remover

EQUIPMENT: Air Gun
Safety Goggles
Sponge
Masking Tape/Paper Dispenser

Respirator
Spray Gun
Air Hose

SAFETY PRECAUTIONS:

1. Safety goggles
2. Flammable liquids closed properly
3. Equipment
4. Respirator

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Wash area with wax/tar/grease remover.	
3. Feather edge damaged area with #80D production paper.	
4. Sand panel with wet/dry sandpaper.	
5. Mask off areas not to be painted.	
6. Wash areas to be painted with enamel reducer.	
7. Wash area with enamel reducer.	
8. Wash bare metal with metal conditioner.	
9. Mix primer-surfacer.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. Spray bare metal area with enough primer-surfacer to sufficiently build up bare metal area level with painted surface. 11. After primer-surfacer has dried, spot-glaze areas as needed. 12. After glazing putty is dry, block sand with #320 w/d abrasive paper and water. 13. Spray area with primer. 14. Repeat steps 11, 12 and 13 using #360 or #400 w/d abrasive paper until area is ready for color coat. 15. Prepare color coat in a separate spray gun. 16. Wash area with enamel reducer. 17. Blow dust the area to be painted and wipe with tack rag. 18. Apply specialized solvent and color coats as specified by the manufacturer. 19. Clean up area.	NOTE: Allow sufficient drying between each coat of primer-surfacer.

METHOD OF EVALUATION:

1. Check on proper cleaning of area to be sanded.
2. Wheels sanded with proper abrasive paper.
3. Tires masked properly.
4. Check on treatment of bare metal.
 - A. Metal conditioner
 - B. Sufficient coats of primer
5. Wipe down with enamel reducer.
6. Blow down and tack wipe.
7. Check on proper thinning of color coat.
8. Check on proper use of spray equipment.
9. Check on proper clean up after sufficient drying.
10. Time: 2 to 3 hours.

JOB: Stripe Body as Required by Hand

JOB SHEET
IDENTIFICATION CODE

UNIT II: Spray Painting

JOB NUMBER: J-2-15

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
Colorcoat Enamel Reducer
Hand Rubbing Compound
Tack Rag
Special Tape

Mixing Paddles
Paper or Cloth Wipers
Paint Strainers
Lacquer Thinner (Medium)

EQUIPMENT: Striping Kit
Air Gun
Squeegee

Air Hose
Masking Tape/Paper Dispenser
Safety Goggles

TOOLS: Shop Knife

SAFETY PRECAUTIONS:

1. Safety goggles
2. Equipment
3. Flammable liquids closed properly
4. Shop knife

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Wash area with wax/tar/grease remover.	
3. Mask off areas not to be painted.	
4. Wash area with enamel reducer.	
5. Mix color coat.	. SC-2-13
6. Prepare striping tool or brush.	
7. Blow dust the area to be painted and wipe with tack rag.	
8. Apply the strip to the body.	
9. After sufficient drying time, hand compound the area.	
10. Remove masking either prior to or after compounding.	

METHOD OF EVALUATION:

1. Check on proper cleaning of area to be striped.
2. Vehicle was masked properly.
3. Striping tape is on uniformly and accurate.
4. Wipe down with enamel reducer.
5. Check for preparation of color coat.
6. Check on proper use of tack rag.
7. Check on proper use of striping tool or brush.
8. Check on proper hand compounding.
9. Check on proper clean-up of car.
10. Time: 2 to 4 hours.

JOB: Stripe Body with Decals
UNIT II: Spray Painting
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-2-16

MATERIAL: Wax/Tar/Grease Remover
Hand Rubbing Compound
Paper or Cloth Wipers

Decal Kit
Masking Tape

EQUIPMENT: Squeegee
Needle

Heat Gun
Safety Goggles

TOOLS: Shop Knife

Scissors

SAFETY PRECAUTIONS:

1. Safety goggles
2. Heat gun
3. Shop knife

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Wash area with wax/tar/grease remover.
3. Align and apply transfer decal to the panel.
4. Smooth with squeegee to remove air bubbles.
(Pin for air bubbles).
5. Apply heat to remove air bubbles, if necessary.
6. Clean up area.

, SC-2-14

METHOD OF EVALUATION:

1. Check on proper cleaning of area.
2. Check on proper alignment of decal.
A. Decal transfer accurate
3. Check on removal of all air bubbles.
4. Check for proper clean-up.
5. Time: 2 to 3 hours.

JOB: Stripe Body as Required by Spray
(Special tape for masking)

JOB SHEET
IDENTIFICATION CODE

UNIT II: Spray Painting

JOB NUMBER: J-2-17

COURSE: Automotive Body and Fender

MATERIAL: Wax/Tar/Grease Remover
Special Tape
Paper or Cloth Wipers
Color Coat
Tack Rag

Enamel Reducer
Hand Rubbing Compound
Mixing Paddles
Paint Strainers
Lacquer Thinner Medium

EQUIPMENT: Spray Gun
Air Gun
Masking Tape/Paper Dispenser
Squeegee

Safety Goggles
Respirator
Air Hose

TOOLS: Shop Knife

SAFETY PRECAUTIONS:

1. Safety goggles
2. Equipment
3. Respirator
4. Flammable liquid closed properly
5. Shop knife

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Wash area with wax/tar/grease remover.	
3. Mask off areas not to be painted.	
4. Wash area with enamel reducer.	
5. Mix color coat.	
6. Blow dust the area to be painted and wipe with tack rag.	
7. Apply the strip to the body.	
8. After sufficient drying time hand compound the area.	
9. Remove masking either prior to or after compounding.	

METHOD OF EVALUATION:

1. Check on proper cleaning of area to be striped.
2. Vehicle is masked properly.
3. Striping tape is on uniformly and accurate.
4. Wipe down with enamel reducer.
5. Check on preparation of color coat.
6. Tack rag used properly.
7. Check for proper use of spray equipment.
8. Hand compound was applied properly.
9. Check for proper clean up.
10. Time: 2 to 3 hours

JOB: Remove and Replace Battery

UNIT II Electricity

COURSE: Automotive Body and Fender

MATERIAL: New Battery

EQUIPMENT: Safety Goggles
Fender Covers

TOOLS: Combination Wrench Set
Regular Screwdriver Set
Ball Peen Hammer

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-1

Battery Terminal Cleaner
Battery Carrier

3/8" Drive Socket Set
Battery Cable Puller
Battery Pliers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Protective clothing and shoes

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: New battery may need to be activated as per SC-3-1 and SC-3-2.
2. Remove the cables from the battery posts.	
3. Remove the hold down.	
4. Remove the battery.	
5. Install new battery.	
6. Clean all connections and battery posts with a terminal cleaner.	
7. Replace hold down and secure.	
8. Replace cables to proper posts.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check removal of old battery.
 - A. Handling of tools
 - B. Cleaning of terminals
 - C. Protective covering
 - D. Battery removal from car
2. Check on installation of new battery.
 - A. Check acid level
 - B. Terminals tight
 - C. Hold down tight
 - D. Clean up tools and equipment
3. Time: 20 minutes

JOB: Remove and Replace a Generator

JOB SHEET
IDENTIFICATION CODE

UNIT III: Electricity

COURSE: Automotive Body and Fender

JOB NUMBER: J-3-2

MATERIAL: Generator

Can 3 and 1 Oil

EQUIPMENT: Fan Belt Tension Gage
Safety Goggles

Fender Cover
Pully Puller Kit

TOOLS: Combination Wrench Set
3/8" Drive Socket Set

Pry Bar

SAFETY PRECAUTIONS:

1. Safety goggles
2. Protective clothing and shoes
3. Removal of battery terminal

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove battery cables.	
3. Remove wires from generator.	
4. Remove generator.	
5. Remove pully from old generator (if needed).	
6. Install pully on new generator (if needed).	
7. Install generator and secure wires.	
8. Connect battery cables.	
9. Clean up the area.	

METHOD OF EVALUATION:

1. Check removal of old generator.
 - A. Protective covering
 - B. Handling of tools
 - C. Removal and installation of pully
2. Check on installation of new generator.
 - A. Check mounting bolts for tightness
 - B. Belt tension
 - C. Clean up tools and equipment
3. Time: 20 minutes.

JOB: Remove and Replace an Alternator

UNIT III: Electricity

COURSE: Automotive Body and Fender

MATERIAL: Alternator
Can 3 and 1 Oil

EQUIPMENT: Pulley Puller Kit
Fan Belt Tension Gage

TOOLS: Combination Wrench Set
Pry Bar

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-3-3

Safety Goggles
Fender Cover

3/8" Drive Socket Set

SAFETY PRECAUTIONS:

1. Safety goggles
2. Protective clothing and shoes
3. Removal of battery terminal

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Remove battery cable.	
3. Remove wires from alternator.	
4. Remove alternator.	
5. Remove pulley from old alternator (if needed).	
6. Install pulley on new alternator (if needed).	
7. Install alternator and secure wires.	
8. Replace battery cable.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check removal of old alternator.
 - A. Protective covering
 - B. Handling of tools
 - C. Removal and installation of pulley
2. Check installation of new alternator.
 - A. Check mounting bolts for tightness
 - B. Belt tension
 - C. Clean up of tools and equipment
3. Time: 20 minutes

JOB: Repair Frame, Sidesway, Sag and Mash
Unitized Body (Front and Rear)

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Frame Work

JOB NUMBER: J-4-1

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary
Machine and Attachments
Safety Goggles
Frame Gage Set
Safety Stands

Floor Jack
Fire Extinguisher
Paint Brush
Oxy-acetylene Welding Outfit

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Equipment
3. Safety stands
4. Footwear and clothing
5. Removal of flammable materials from area.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check for type and amount of damage.
4. Roll the machine into proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operations.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
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Type B. Stationary Machine

- | | |
|--|----------|
| 1. Analyze the job. | . SC-4-1 |
| 2. Place the car on frame rack. | |
| 3. Install frame gages and check for type and amount of damage, then remove. | |
| 4. Hook up all frame attachments and secure. | |
| 5. Apply pressure and proceed with straightening operation. | |
| 6. Check frame for alignment. | |
| 7. Repeat steps five and six until frame meets factory specifications. | |
| 8. Remove all frame attachments and remove car from rack. | |
| 9. Clean up area. | |

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gages installed properly
 - B. Gages installed at proper points
3. Check on proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening
 - D. Cracking of frame from pulling
4. Proper alignment secured.
5. Check on proper use of frame equipment.
 - A. Storage of equipment
 - B. Cleaning of equipment
6. Check on proper use of welding equipment
7. Time: 6-12 hours

JOB: Repair Frame Cross Member Sag

UNIT IV: Frame Work

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary Machine
and Attachments
Safety Stands
Floor Jack
Safety Goggles

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Equipment
3. Safety stands
4. Footwear and clothing
5. Removal of flammable material from area

**JOB SHEET
IDENTIFICATION CODE**

JOB NUMBER: J-4-2

Frame Gage Set
Oxy-acetylene Welding Outfit
Fire Extinguisher
Paint Bursh

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check amount of sag damage, then remove.
4. Roll the machine into the proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operation.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

Type B. Stationary Machine

1. Analyze the job.
2. Place car on frame work.
3. Install frame gages and check amount of sag damage, the remove. . SC-4-1
4. Hook up all frame attachments and secure.
5. Apply pressure and proceed with straightening operation.
6. Check frame for alignment.
7. Repeat steps five and six until frame meets factory specifications.
8. Remove all frame attachments and remove car from the rack.
9. Clean up the area.

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gages installed properly
 - B. Gages installed at proper points
3. Check proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening completed
 - D. Cracking of frame or welds from pulling
4. Proper alignment was obtained?
5. Check proper use of frame equipment.
 - A. Storage of equipment
 - B. Cleaning of equipment
6. Check proper use of welding equipment.
7. Time: 4 to 8 hours.

JOB: Repair Frame Horn, Sidesway, Sag and
Mash Regular Frame Front

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Frame Work

JOB NUMBER: J-4-3

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary Machine
and Attachments
Paint Brush
Safety Stands
Oxy-acetylene Welding Outfit

Safety Goggles
Fire Extinguisher
Floor Jack
Frame Gage Set

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Equipment
3. Safety stands
4. Footwear and clothes
5. Removal of flammable materials from area.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check for type and amount of damage.
4. Roll the machine into proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operations.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

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Type B. Stationary Machine

1. Analyze the job.
2. Place the car on frame rack.
3. Install frame gages and check for type and amount of damage, then remove. . SC-4-1
4. Hook up all frame attachments and secure.
5. Apply pressure and proceed with straightening operation.
6. Check frame for alignment.
7. Repeat steps five and six until frame meets factory specifications.
8. Remove all attachments and remove car from rack.
9. Clean up the area.

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gage installed properly
 - B. Gage installed at proper points
3. Check proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening completed
 - D. Cracking of frame or welds from pulling
4. Proper alignment obtained.
5. Check proper use of frame equipment.
 - A. Storage of equipment
 - B. Cleaning of equipment
6. Check proper use of welding equipment.
7. Time: 6 to 10 hours.

JOB: Repair Frame Sidesway, Sag and
Mash Regular Frame (Rear)

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Frame Work

JOB NUMBER: J-4-4

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary Machine
and Attachments
Paint Brush
Safety Stands
Safety Goggles

Fire Extinguisher
Floor Jack
Frame Gage Set
Oxy-acetylene Welding Outfit

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Gas tank safety (right by repair area)
3. Equipment
4. Safety stands
5. Footwear and clothes
6. Removal of flammable material from area

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check for type and amount of damage.
4. Roll the machine into proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operations.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
<u>Type B. Stationary Machine</u>	
1. Analyze the job.	
2. Place the car on frame rack.	
3. Install frame gages and check for type and amount of damage, then remove.	
4. Hook up all frame attachments and secure.	. SC-4-1
5. Apply pressure and proceed with straightening operation.	
6. Check frame for alignment.	
7. Repeat steps five and six until frame meets factory specifications.	
8. Remove all attachments and remove car from rack.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gages installed properly
 - B. Gages installed at proper points
3. Check proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening completed
 - D. Cracking of frame or welds from pulling
4. Proper alignment obtained.
5. Check proper use of frame equipment.
 - A. Cleaning of equipment
 - B. Storage of equipment
6. Check proper use of welding equipment.
7. Time 4 to 10 hours.

JOB: Repair Frame Twist Damage

JOB SHEET
IDENTIFICATION CODE

UNIT IV: Frame Work

JOB NUMBER: J-4-5

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary Machine
and Attachments
Safety Stands
Floor Jack
Paint Brush

Safety Goggles
Frame Gage Set
Oxy-acetylene Welding Outfit
Fire Extinguisher

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Gas tank safety (right by repair area)
3. Equipment
4. Safety stands
5. Footwear and clothes
6. Removal of flammable material from area

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check amount of damage, then remove.
4. Roll the machine into its proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operations.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
<u>Type B. Stationary Machine</u>	
1. Analyze the job.	
2. Place car on frame rack.	
3. Install frame gages and check for type and amount of damage, then remove.	. SC-4-1
4. Hook up all frame attachments and secure.	
5. Apply pressure and proceed with straightening operations.	
6. Check frame for alignment.	
7. Repeat steps five and six until frame meets factory specifications.	
8. Remove all attachments and remove car from rack.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gages installed properly
 - B. Gages installed at proper points
3. Check on proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening completed
 - D. Cracking of frame or welds from pulling
4. Proper alignment obtained.
5. Check proper use of frame equipment.
 - A. Cleaning of equipment
 - B. Storage of equipment
6. Check proper use of welding equipment.
7. Time: 3 to 8 hours.

JOB: Repair Frame Diamond Damage

UNIT IV: Frame Work

COURSE: Automotive Body and Fender

MATERIAL: Frame Paint

EQUIPMENT: Portable or Stationary Machine
and Attachments
Safety Stands
Floor Jack
Paint Brush

TOOLS: Assorted Hammers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Gas tank safety (right by repair area)
3. Equipment
4. Safety stands
5. Footwear and clothes
6. Removal of flammable material from area

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-6

Safety Goggles
Frame Gage Set
Oxy-acetylene Welding Outfit
Fire Extinguisher

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

Type A. Portable Machine

1. Analyze the job.
2. Place car in proper position on safety stands.
3. Install frame gages and check amount of damage, then remove.
4. Roll the machine into its proper position.
5. Hook up all frame attachments and secure.
6. Apply pressure and proceed with straightening operations.
7. Check frame for alignment.
8. Repeat steps six and seven until frame meets factory specifications.
9. Disassemble frame machine and remove safety stands.
10. Clean up the area.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
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Type B. Stationary Machine

1. Analyze the job.
2. Place car on frame rack.
3. Install frame gages and check for type and amount of damage, the remove. . SC-4-2
4. Hook up all frame attachments and secure.
5. Apply pressure and proceed with straightening operations.
6. Check frame for alignment.
7. Repeat steps five and six until frame meets factory specifications.
8. Remove all attachments and remove car from rack.
9. Clean up the area.

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
 - B. Level
2. Check on damage.
 - A. Gages installed properly
 - B. Gages installed at proper points
3. Check proper positioning of machine.
 - A. Frame attachments secure
 - B. Pressure applied slowly
 - C. Amount of straightening completed
 - D. Cracking of frame or welds from pulling
4. Proper alignment obtained.
5. Check proper use of frame equipment.
 - A. Cleaning of equipment
 - B. Storage of equipment
6. Check proper use of welding equipment.
7. Time: 4 to 10 hours.

JOB: Align Front End

UNIT IV: Frame Work

COURSE: Automotive Body and Fender

MATERIAL: Shims

EQUIPMENT: Front End Alignment Equipment
Fender Covers

TOOLS: Open End and Box Wrench Set
Diagonal Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-4-7

Safety Goggles
Manufacturer's Specifications
Book or Chart

3/8" Drive Socket Set
Special Front End Hand
Tools and Equipment

SAFETY PRECAUTIONS:

1. Safety goggles
2. Alignment equipment
3. Driving onto rack
4. Footwear and clothes
5. Removal of car from rack

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Calibrate the equipment and rack.	. SC-4-3
3. Drive vehicle on alignment rack.	
4. Prepare vehicle for alignment.	
5. Check tracking.	. SC-4-2
6. Check right and left front wheels for camber.	. SC-4-5
7. Check right and left front wheels for caster.	. SC-4-4
8. Check toe in alignment.	. SC-4-6
9. Clean up area.	

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safely installed on rack
 - B. Aligned and level on rack
2. Check on alignment.
 - A. Check tracking
 - B. Check camber
 - C. Check caster
 - D. Check toe in
3. Proper alignment obtained.
4. Check proper use of alignment equipment.

JOB: Rebuild a Master Cylinder

UNIT V: Hydraulics--Vacuum and Air

COURSE: Automotive Body and Fender

MATERIAL: Master Cylinder
Cloth or Paper Wipers

EQUIPMENT: Hone Kit

TOOLS: 3/8" Socket Set
Combination Wrench Set
Regular Screwdrivers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-1

Brake Fluid

Safety Goggles

Line Wrench Set
Lock Ring Pliers
3/8" Electric Drill

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Detach brake pedal link.	
3. Detach brake lines.	
4. Remove bolts holding cylinder to body.	
5. Remove filler plug and drain fluid.	
6. Remove boot and push rod.	
7. Remove snap ring and stop plate.	
8. Remove interior piston and parts.	
9. Wash all parts in brake system with cleaning fluid.	
10. Inspect cylinder and piston for score marks.	
11. Remove marks with crocus cloth or hone (if needed).	. SC-5-1
12. Check piston fit in cylinder.	
13. Lubricate all new parts with brake fluid.	
14. Replace interior piston and new parts.	
15. Replace snap ring and stop plate.	
16. Replace boot and push rod.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
17. Replace filler plug.	
18. Replace fluid.	
19. Depress the push rod and holding finger over the outlet hole, release push rod.	
20. Repeat this process until a steady stream of brake fluid comes from the outlet when the push rod is depressed.	
21. Replace cylinder to body of car.	
22. Replace lines.	
23. Replace brake pedal linkage.	
24. Refill with brake fluid.	
25. Bleed brake system.	
26. Clean up area.	

METHOD OF EVALUATION:

1. Safe and proper use of equipment and goggles.
2. Check condition of cylinder.
3. Check all brake and wheel parts before reassembly.
4. Time: 1 hour.

JOB: Reline Disc Brakes Hydraulic System

UNIT V: Hydraulics--Vacuum and Air

COURSE: Automotive Body and Fender

MATERIAL: Set of Lining
Brake Fluid

EQUIPMENT: Safety Goggles
Safety Stands
Dial Indicator

TOOLS: Rubber Mallet
Regular Screwdrivers
Channel Lock Pliers
Specialized Brake Tools
Line Wrenches

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-2

Cloth Wipers

Hydraulic Jack
Brake Bleeder

Ball Peen Hammer
Diagonal Cutting Pliers
3/8" Socket Set
Lug Wrench

SAFETY PRECAUTIONS:

1. Safety goggles
2. Safety stands
3. Equipment

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	NOTE: Follow shop manual procedures.
2. Support the car on a hoist or safety stand.	
3. Remove the wheel cover.	
4. Mark a hub stud and its corresponding hole in the wheel to retain the wheel balance.	
5. Remove the wheel.	
6. Put the brake parts into hub cap.	
7. Remove caliber splash shield retainer plate.	
8. Remove the caliber if needed.	
9. Use two pliers to pull out disc brake shoes.	

NOTE: After the shoes are removed from the caliber the pistons are pushed into their cylinder bores by prying against the brake disc. If the pistons don't move freely, the caliber must be overhauled.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. Install new brake lining.	NOTE: Use an outside micrometer to determine if the brake disc has worn beyond manufacturer's specifications. Also check the disc for thickness variation by measuring the disc at its circumference in three or more places.
11. Replace the caliber or splash shield.	
12. Replace the wheel in proper location and secure.	
13. Replace the wheel cover.	
14. Lower the car.	
15. Clean up area.	

METHOD OF EVALUATION:

1. Check position of car.
 - A. Safety stands installed properly
2. Check removal of brake shoes.
 - A. Removal of wheel
 - B. Removal of braking disc (if needed)
 - C. Handling of tools
3. Check installation of brake shoes.
 - A. Installation of braking disc (if needed)
 - B. Adjust brake shoes
 - C. Installation of wheel
 - D. Bleed brakes (if needed)
4. Proper use of tools and equipment.
5. Time: 2 hours

JOB: Reline Drum Brakes Hydraulic System

UNIT V: Hydraulics--Vacuum and Air

COURSE: Automotive Body and Fender

MATERIAL: Cotter Pin
Set of Lining
Brake Fluid

EQUIPMENT: Safety Goggles
Hydraulic Jack

TOOLS: Specialized Brake Tool Kit
Regular Screwdrivers
Channel Lock Pliers

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-3

Paper or Cloth Wipers
Wheel Bearing Grease

Brake Bleeder
Safety Stands

Ball Peen Hammer
Rubber Mallet
Diagonal Cutting Pliers

SAFETY PRECAUTIONS:

1. Safety goggles
2. Safety stands
3. Equipment
4. Cotter pin

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Lift the car and install safety stands.
3. Remove wheel cover.
4. Remove dust cap.
5. Remove cotter key.
6. Remove spindle nut.
7. Remove bearing and race.
8. Remove wheel and hub assembly.
9. Install cylinder clamp onto wheel cylinder.
10. Remove springs from anchor pin with specialized tool.
11. Remove shoe hold downs with specialized tool.
12. Remove shoes.
13. Install shoes with new lining on.

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COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
14. Loosen and free adjuster wheel.	NOTE: At this point check the wheel cylinder for leakage.
15. Correctly install all of the brake shoes onto the backing plates.	
16. Install springs correctly on to the anchor pin first.	
17. Install hold down springs using proper specialized tool.	
18. If the brake design has adjustable anchor pin, adjust anchor pin.	
19. Install the wheel and hub assembly.	
20. Install bearing and race.	
21. Install nut and secure.	NOTE: Be careful not to overtighten wheel bearing.
22. Install new cotter pin.	
23. Replace dust cap.	
24. Replace wheel cover.	
25. Remove the rubber dust cover on backing plate.	
26. Tighten star wheel until wheel is locked.	
27. Back off five or six notches on star wheel until wheel has slight drag.	
28. Lower car to floor.	
29. Clean up area.	

METHOD OF EVALUATION:

1. Check position of car on safety stands.
2. Check removal of brake lining.
 - A. Removal of wheel and drum assembly
 - B. Removal of brake shoes
3. Proper inspection of wheel cylinder.
4. Proper installation of new lining.
 - A. Replace wheel and drum assembly
 - B. Tightness of wheel bearing
 - C. Bleed brakes
 - D. Adjustment of brakes
5. Proper use of tools and equipment.
6. Time: 2-1/2 hours

JOB: Rebuild Wheel Cylinder

JOB SHEET
IDENTIFICATION CODE

UNIT V: Hydraulics--Vacuum and Air

JOB NUMBER: J-5-4

COURSE: Automotive Body and Fender

MATERIAL: Wheel Cylinder Rebuild Kit
Cloth Wipers
Brake System Cleaning Fluid

Brake Fluid
Crocus Cloth

EQUIPMENT: Safety Goggles
Floor Jack
Hone Kit (Wheel Cylinder)

Safety Stands
Brake Bleeder

TOOLS: Combination Wrench Set
3/8" Electric Drill

Specialized Brake Tools
Line Wrench Set

SAFETY PRECAUTIONS:

Use safety goggles.

<u>COMPETENCE - PROCEDURE/STEPS</u> The student will be able to:	<u>TEACHING/LEARNING ACTIVITIES</u>
1. Analyze the job.	
2. Lift the car and place on safety stands.	
3. Disconnect hydraulic line at wheel cylinder.	
4. Remove screws holding cylinder to backing plate and remove cylinder.	
5. Remove rubber boots and take out pistons, cups, expanders and springs.	
6. Remove bleeder valve.	
7. Wash all parts in brake system cleaning fluid.	
8. Check brake cylinder body for cracks, sand holes or bad bleeder threads.	
9. Check bore finish.	
10. Mount wheel cylinder in vise.	
11. Hone wheel cylinder if needed.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
12. Reclean parts.	
13. Dip pistons and cups in brake fluid.	
14. Coat bore of cylinder with brake cylinder fluid.	
15. Install piston, cup, spring and boot.	
16. Install bleeder valve assembly.	
17. Install wheel cylinder to the brake backing plate with holding screws.	
18. Hook up hydraulic line.	
19. Attach a bleeder hose to the bleeder screw and place the other end of hose in a clean container of brake fluid.	
20. Fill master cylinder reservoir with brake fluid.	
21. Open the bleeder screw 3/4 or a turn.	
22. Depress brake pedal slowly to the floor.	
23. Repeat this step until the fresh brake fluid has no air bubbles flowing into the container.	
24. Tighten the bleeder screw.	
25. Remove the bleeder hose.	
26. Refill the master cylinder.	
27. Clean up area.	

METHOD OF EVALUATION:

1. Check removal of wheel cylinder.
2. Proper inspection of wheel cylinder.
3. Smooth out interior of wheel cylinder.
4. Check installation of new wheel cylinder kit.
5. Check installation of wheel cylinder to backing plate.
 - A. Check bolts for tightness
 - B. Check for leaks
 - C. Check brake lines
6. Check proper use of tools
7. Time: 60 minutes.

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JOB: Replace Rubber or Steel Brake Line

UNIT V: Hydraulics--Vacuum and Air

COURSE: Automotive Body and Fender

MATERIAL: Steel Tubing (Type A) or
Flexible Line (Type B)

EQUIPMENT: Safety Goggles
Safety Stands

TOOLS: Tubing Cutter
Flaring Tool
Line Wrench Set

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-5-5

Fittings (Assortment)
Brake Fluid

Floor Jack

Combination Wrench Set
Regular Screwdrivers
Lock Joint Pliers

SAFETY PRECAUTIONS:

1. Use safety goggles
2. Proper use of equipment

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job.	
2. Lift the car and install safety stand.	
3. Cut off damaged steel tubing or if a flexible line is used, remove it.	
4. Ream out any bores or rough edges on inside edge of tubing.	
5. Cut new tubing to desired length and form to desired shape.	
6. Select proper fittings and install on tubing.	
7. Fasten tubing in flaring tool.	
8. Place proper size plug of gage down in end of tubing.	
9. Screw in until plug gage has seated in jaws of flaring tool.	
10. Remove flaring tool from tubing.	

NOTE: Use this procedure for all ends which need flaring.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Install new steel or flexible line.	
12. Attach a bleeder hose to the bleeder screw and place other end of hose in clean container of brake fluid.	
13. Fill master cylinder reservoir with brake fluid.	
14. Open the bleeder screw 3/4 of a turn.	
15. Depress brake pedal, slowly to the floor.	
16. Repeat this step until fresh brake fluid with no air bubbles flows into container.	
17. Tighten the bleeder screw.	
18. Remove the bleeder hose.	
19. Refill the master cylinder.	
20. Clean up area.	

METHOD OF EVALUATION:

1. Car properly positioned on safety stands.
2. Damaged line removed.
3. Checks proper preparation of new line.
 - A. Cutting
 - B. Flaring
 - C. Installation of fittings
4. Check proper installation of new line.
 - A. Check fittings for tightness
 - B. Check for leaks
5. Check proper use of tools and equipment.
6. Time: 60 minutes.

JOB: Repair Radiator Neck Opening

UNIT VII: Radiator Repair

COURSE: Automotive Body and Fender

MATERIAL: Solder
Copper Sheet
Acid
Paint

EQUIPMENT: Pressurizing System
Prestolite Tank with Solder Tip
Rubber Gloves
Rubber Plugs
Safety Goggles

TOOLS: Tin Shears
Wire Brush

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-7-1

Thinner
Cloth Wiper
Acid Swab

Radiator Clamping Device
Rubber Aprons
Spray Gun
Dip Tank with Water

Acid Brush

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Clean the area to be repaired with a wire brush using heat and muriatic acid alternately.
2. Tin an area at least one inch larger than all points of the crack.
3. Cut a patch from 16 oz. copper sheet .021 to a size that covers the tinned area.
4. Tin both sides of the copper patch.
5. Heat and apply a thin layer of solder over the crack and tinned area.
6. Position patch, heat and flow additional solder around edges of patch and cool with water.
7. Wash patched area thoroughly and leak test at the proper air pressure.
8. Spray paint repaired area.
9. Clean up area.

METHOD OF EVALUATION:

1. Check cleanliness of surface to be soldered.
2. Check on proper timing.
3. Check repairs for leaks.
4. Time: 1 hour.

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JOB: Repair Radiator Tubes
UNIT VII: Radiator Repair
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-7-2

MATERIAL: Solder
Acid
Paint

Thinner
Wipes

EQUIPMENT: Pressurizing System
Prestolite Tank with Solder Tip
Rubber Gloves
Rubber Plugs
Radiator Clamping Device

Rubber Apron
Spray Gun
Dip Tank with Water
Safety Goggles

TOOLS: Wire Brush
Acid Brush

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Wear goggles.	
2. Heat the tube area to be repaired.	
3. Move or spread fins slightly to gain access to the leak.	
4. Clean the area to be repaired with a wire brush using heat and muriatic acid alternately.	
5. Completely clean the area, then heat and flow solder to cover the leak.	
6. Restore fins to their original position by using duck bill pliers.	
7. Test with required air pressure.	
8. Spray paint repaired area.	
9. Clean up area.	

METHOD OF EVALUATION:

1. Check cleanliness of surface to be soldered.
2. Check proper timing.
3. Check repairs for leaks.
4. Time: 1 hour.

JOB: Repair Radiator Core
UNIT VII: Radiator Repair
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-7-3

MATERIAL: Solder
Muriatic Acid
Paint
Thinner

Cloth Wipers
Acid Brush
Tube Brush

EQUIPMENT: Pressurizing System
Prestolite Tank with Solder Tip
Rubber Gloves
Rubber Plugs
Respirator
Air Hose

Rubber Apron
Spray Gun
Dip Tank with Water
Safety Goggles
Radiator Clamping Device

TOOLS: Wire Brush

SAFETY PRECAUTIONS:

1. Safety goggles worn
2. Rubber gloves worn
3. Rubber apron worn
4. Safe holding device
5. Equipment used properly
6. Removal of flammable material from area
7. Use of respirator

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Analyze the job.
2. Place radiator on a stand or in a holding device.
3. Clean the area to be repaired.
4. Make repairs as needed according to type of damage.
5. Wash repaired area thoroughly and leak test at the proper air pressure.
6. Spray paint repaired area.

CAUTION: Wear safety goggles.

METHOD OF EVALUATION:

1. Check position of radiator on stand.
2. Check on proper cleaning of area to be repaired.
 - A. Muriatic Acid
 - B. Acid Brush
 - C. Tube Brush
3. Check for proper repairs.
 - A. Soldering
4. Proper use of soldering equipment.
5. Proper use of spraying equipment.
6. Time: 30 minutes to 2 hours.

JOB: Replace Radiator Core
UNIT VII: Radiator Repair
COURSE: Automotive Body and Fender

JOB SHEET
IDENTIFICATION CODE

JOB NUMBER: J-7-4

MATERIAL: New Core
Solder
Muriatic Acid
Paint

Thinner
Cloth Wipers
Acid Brush
Tube Brush

EQUIPMENT: Pressurizing System
Prestolite Tank with Solder Tips
Rubber Gloves
Rubber Plugs
Radiator Clamping Device
Respirator

Air Hose
Rubber Apron
Spray Gun
Dip Tank with Water
Safety Goggles

TOOLS: Wire Brush

SAFETY PRECAUTIONS:

1. Safety goggles worn
2. Rubber gloves worn
3. Rubber apron worn
4. Safe holding device
5. Equipment used properly
6. Removal of flammable material from area
7. Proper use of respirator

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Analyze the job.
2. Place radiator on stand or in a holding device.
3. Code mark all components to be removed.
4. Apply heat and remove side strips.
5. Apply heat and remove upper tank.
6. Apply heat and remove lower tank.
7. Remove damaged core and insert new core.
8. Align and replace upper tank.
9. Align and replace lower tank.

CAUTION: Wear safety goggles, rubber gloves and apron when blowing solder.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
10. Replace side straps.	
11. Put radiator thru required air pressure test.	
12. Spray paint new core.	
13. Clean up area.	

METHOD OF EVALUATION:

1. Check position of radiator on stand.
2. Check proper coding of material to be removed.
3. Proper use of soldering equipment.
 - A. Remove side straps
 - B. Remove upper tank
 - C. Remove lower tank
 - D. Remove damaged core
4. Proper installation and alignment of new core and parts removed.
5. Successful air pressure test.
6. Proper use of spray equipment.
7. Time: 2 to 4 hours.

JOB: Remove and Replace Radiator Tanks

UNIT VII: Radiator Repair

COURSE: Automotive Body and Fender

MATERIAL: Solder
Acid
Paint

EQUIPMENT: Pressurizing System
Prestolite Tank with Solder Tip
Rubber Gloves
Rubber Plugs

TOOLS: Acid Brush

JOB SHEET
IDENTIFICATION CODE

Job Number: J-7-5

Thinner
Cloth Wiper
Acid Swab

Safety Goggles
Rubber Aprons
Spray Gun
Dip Tank with Water
Radiator Clamping Device

Wire Brush

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Identify all components to be removed with a scribe so that they can be replaced correctly.	CAUTION: Wear safety goggles, rubber shoes and apron when blowing solder.
2. Apply heat to lip of header and when solder is molten, blow away with air blow gun.	
3. Continue around lip until all solder is removed from lip channel.	
4. Heat one side of the header tank seam moving torch alternately from one end to the other until tank's side seam becomes loose.	
5. Repeat the procedure with other side and ends until tank is removed.	
6. Remove other tank, if required, in the same manner.	
7. Check both header and tank for proper fit and alignment before replacing tank.	

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
8. Clean and tin the same portion of header in preparation for soldering to tank.	
9. Fit tank to header and clamp in position.	
10. Apply heat and flow solder in header lip channel until entire lip is completely soldered.	NOTE: Use extreme care to avoid flowing solder inside header and tank. Excessive solder could block the tubes.
11. Put radiator through three required air pressure tests.	
12. Replace all brackets and anchorages that were removed.	
13. Spray paint.	
14. Clean up area.	

METHOD OF EVALUATION:

1. Check cleanliness of surface to be soldered.
2. Check proper timing.
3. Check repairs for leaks.
4. Time: 1 hour.

COMPETENCY: Cut with Tin Shears

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to cut sheet metal using proper tin shears

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Grasp the snips with one hand and the shorter side of the sheet metal with the other.

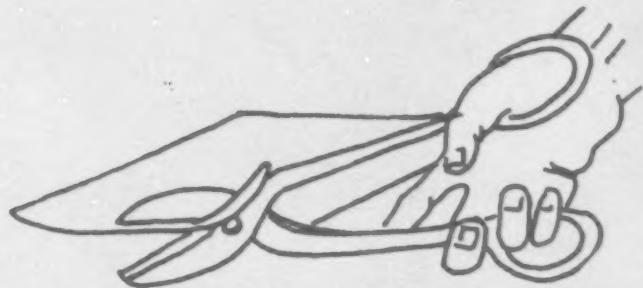


2. Open the blades wide and start the cut at the edge of the sheet.
3. Hold the blades of the snips at a right angle to the sheet and cut.



INTRODUCTION: Snips should be chosen so that they will cut easily and so that they won't be hard to use. For mild steel, 22 gage or lighter, straight or combination snips should be used. For 16 to 20 gage mild steel, bulldog snips are needed.

NOTE: Keep from getting jagged edges by closing the blades just short of the full length.

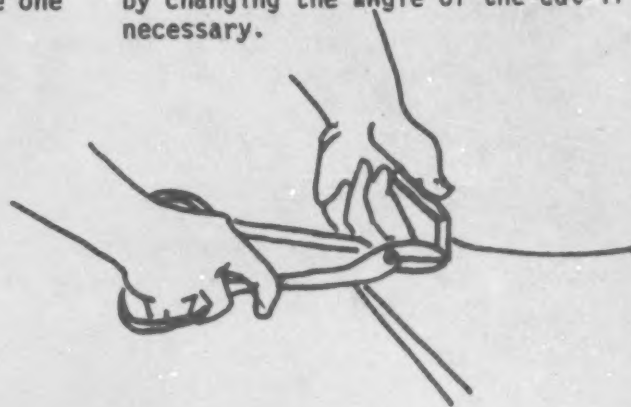


COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Start the next cut at the end of the one before.
5. Finish the cut.

NOTE: Keep the snips on the line by changing the angle of the cut if necessary.



COMPETENCY: Set Up Welding Equipment

COURSE: Automotive Body and Fender

UNIT I: Metal Work

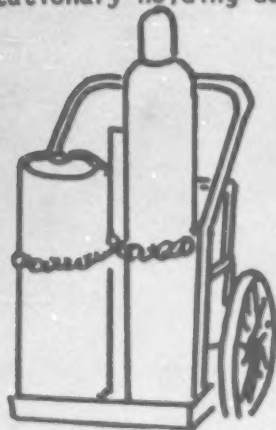
OBJECTIVE: The student will be able to properly set up welding equipment.

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Fasten cylinders to the cart or stationary holding device with chains.



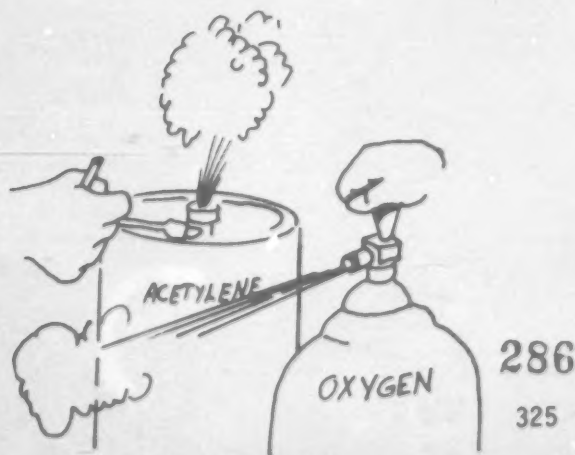
2. Remove cylinder caps from tanks.

3. Crack cylinders by opening and closing, slowly, the cylinder valves to clear the valves of debris and dirt.

INTRODUCTION: Oxy-acetylene equipment, whether used for welding or soldering, is the indispensable tool of the bodyman. It is a potentially dangerous piece of equipment and should be handled with extreme care. Burns and/or serious explosion could result from misuse of the equipment. The regulators are easily damaged and must be handled properly. It is important that one follow the steps given below exactly for proper use of the equipment.

NOTE: When using an oxy-acetylene torch in and around automobiles, great care should be given to gasoline fumes, upholstery, rubber seals, paint materials and plastic filters. A serious fire could be started in seconds.

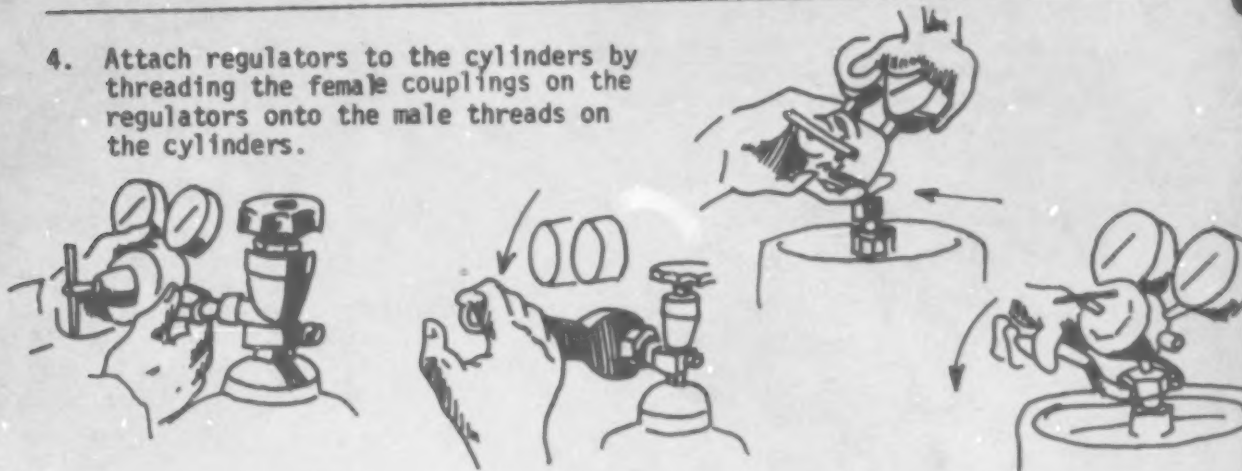
NOTE: Acetylene in a free state can be safely compressed ONLY to a pressure of 14.7 lbs./sq.". This is a maximum safe pressure limit.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Attach regulators to the cylinders by threading the female couplings on the regulators onto the male threads on the cylinders.

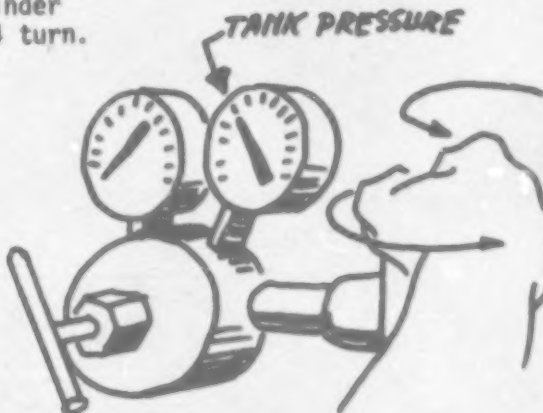


NOTE: Make sure that the thumb-screw valves on both regulators are turned all the way out and free of spring tension so that the diaphragm will not be damaged when gas is turned on.

NOTE: The oxygen regulator has a right-hand thread and the acetylene regulator has a left-hand thread.



5. Slowly open the oxygen cylinder valve all the way.
6. Slowly open the acetylene cylinder valve, using wrench, about 1/4 turn.



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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

7. Attach the oxygen hose to the oxygen regulator, using wrench provided.

NOTE: The oxygen hose has right-hand threads.



8. Attach the acetylene hose to the acetylene regulator.

NOTE: The acetylene hose has left-hand threads



9. Attach the welding torch to the hoses, using the wrench but do not overtighten the couplings.



10. Turn the acetylene regulator screw in to adjust the acetylene working pressure.



11. Check the acetylene system with soapy water.



12. Turn the oxygen regulator screw in to adjust the oxygen working pressure.



13. Check the oxygen system with soapy water.

14. Check the gage connections with soapy water.

15. Check the hose torch connections with soapy water.



COMPETENCY: Clean Welding and Cutting Tips

COURSE: Automotive Body and Fender

UNIT I: Metal Work

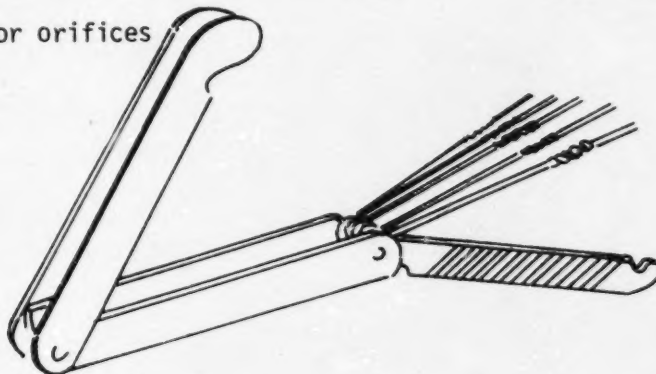
OBJECTIVE: The student will be able to properly clean welding and cutting tips

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Select proper tip cleaner for orifices to be cleaned.



2. Starting with a cleaner one size smaller than the orifice to be cleaned, insert tip cleaner into orifice and work back and forth slowly until tip is cleaned.

CAUTION: Take care not to break the cleaner off in the orifice.

3. Repeat step with proper size cleaner.



4. File the end of the tip lightly until it is square and clean.

5. Re-clean the orifices to remove the burr caused by filing.

6. Place the tip in the torch and blow it out with oxygen.

7. Light the torch and adjust to a neutral flame to test the cleaning job.



COMPETENCY: Light and Shutdown Welding Torch

COURSE: Automotive Body and Fender

UNIT I: Metal Work

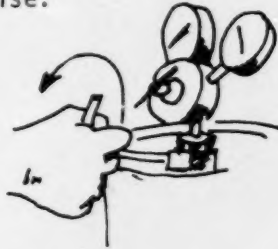
OBJECTIVE: The student will be able to
light and shutdown welding
equipment properly

Page 1 of 3 pages

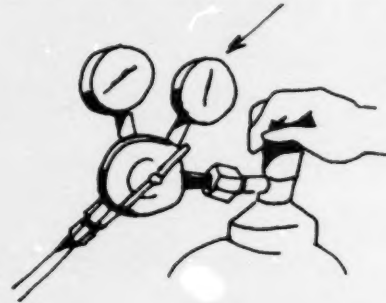
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
------------------------------	------------------------------

NOTE: Make sure the torch valves are closed and the regulator thumbscrews are turned all the way out (no pressure on the diaphragm.)

1. Open oxygen valve slowly all the way.
2. Oper acetylene valve slowly 1/4 of a turn counterclockwise.



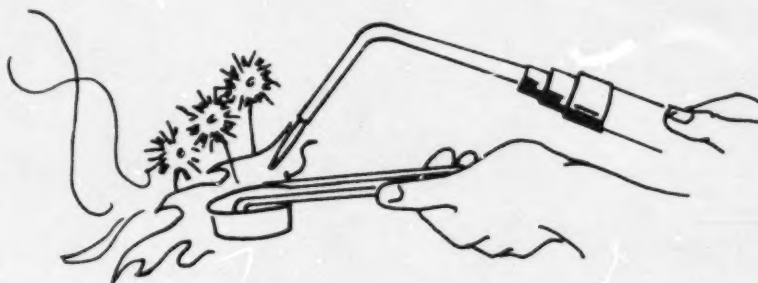
3. Adjust oxygen regulator to working pressure of 8-10 pounds by slowly turning the thumbscrew in (to the right).
4. Adjust acetylene regulator to working pressure of 4-5 pounds.



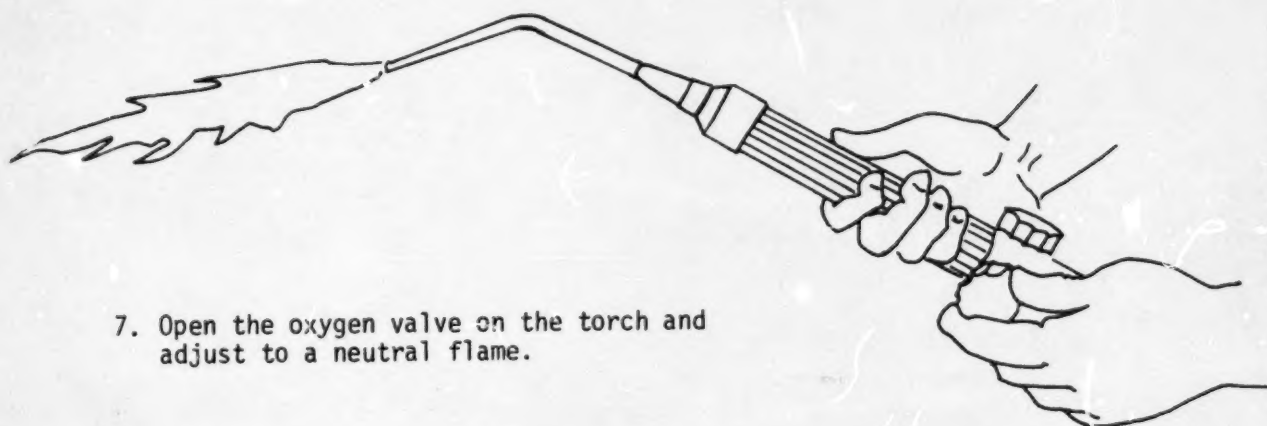
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

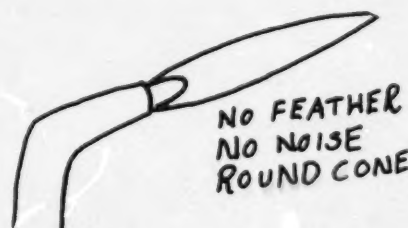
5. Slowly open the acetylene valve on the torch 1/8 to 1/4 of a turn and immediately spark the striker to ignite the acetylene.



6. Readjust the acetylene regulator to proper working pressure.



7. Open the oxygen valve on the torch and adjust to a neutral flame.
8. Shut off torch by first closing the acetylene torch valve then the oxygen torch valve.
9. Turn off acetylene at the cylinder by turning the wrench clockwise.



NOTE: Remember the appearance of the neutral flame from the demonstration.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Turn off oxygen at the cylinder, by turning the valve clockwise. 12. Bleed acetylene the oxygen lines by opening torch valves until both gages read "0". 13. Close acetylene and oxygen regulators by turning thumbscrews counterclockwise until loose. 14. Close valves on the torch finger tight. 15. Replace torch in holder.	

COMPETENCY: Weld Without Filler Rod

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to
efficiently weld without
filler rod

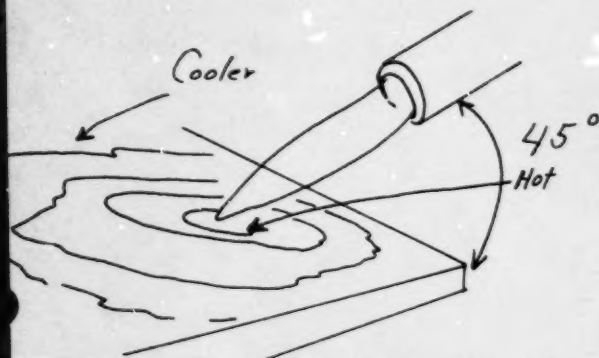
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS

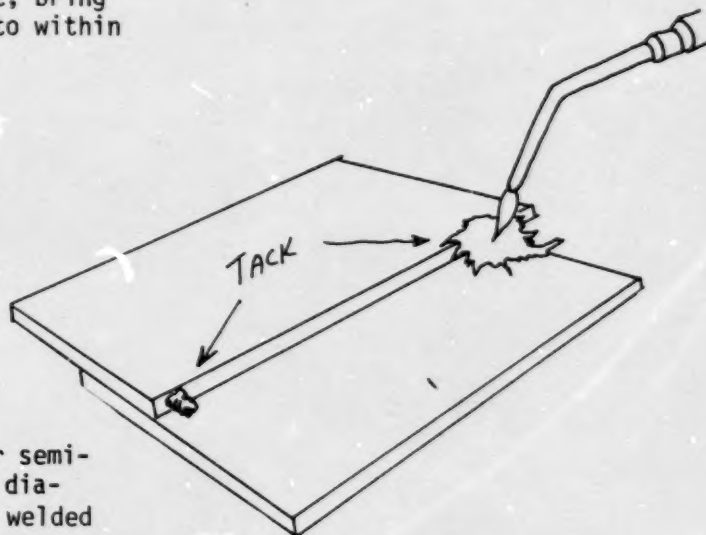
The student will be able to:

TEACHING/LEARNING ACTIVITIES

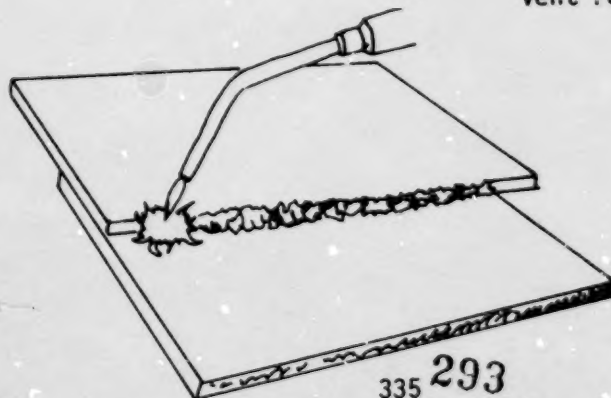
1. Holding the welding torch at a 45° angle to the joint and parallel to it, bring the cone of the neutral flame to within 1/8" of material.



2. Move the torch in a circular or semi-circular pattern about 1/4" in diameter over the spot to be tack welded until the metal is molten (puddle).
3. Remove torch flame from molten spot and allow to cool slightly.
4. Start at the open end of the joint and repeat the pattern and procedure used for tack welding, moving along as fast as the metal will puddle.



NOTE: Moving too fast will cause loss of puddle, and moving too slowly will cause too much metal to be melted. Weld intermittently at the end of the joint to prevent rounding off.



COMPETENCY: Weld With Filler Rod

COURSE: Automotive Body and Fender

UNIT I: Metal Work

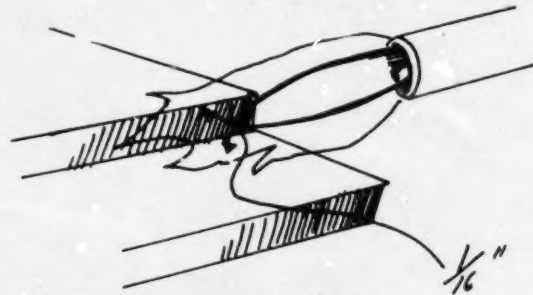
OBJECTIVE: To properly join metal by adding filler rod to puddle

Page 1 of 2 pages

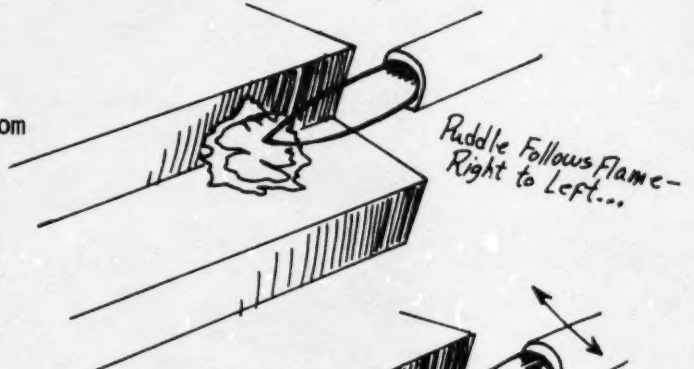
COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Hold the torch at a 45° angle, and, beginning at the right side of the plate, melt the two pieces of metal together -- tack weld.

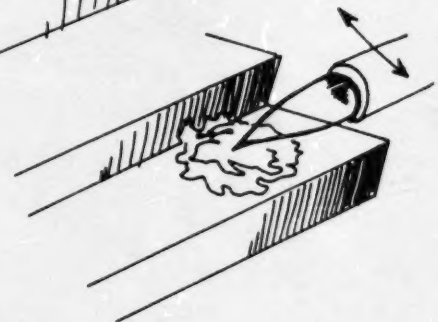
INTRODUCTION: In body work, welding is an important skill. Welding is used in patching, in welding metal breaks, in replacing parts, etc. Fusion welding is joining similar metals.



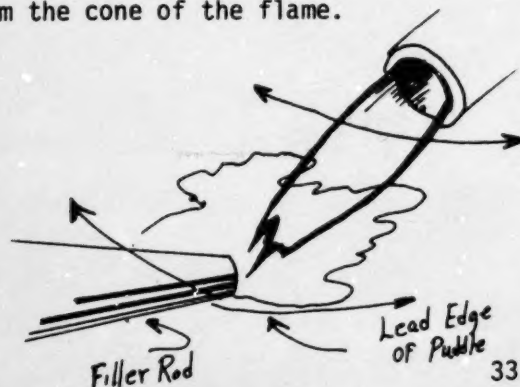
2. Holding the torch at a 45° angle from the direction of travel, melt the edges of the left side -- tack weld.



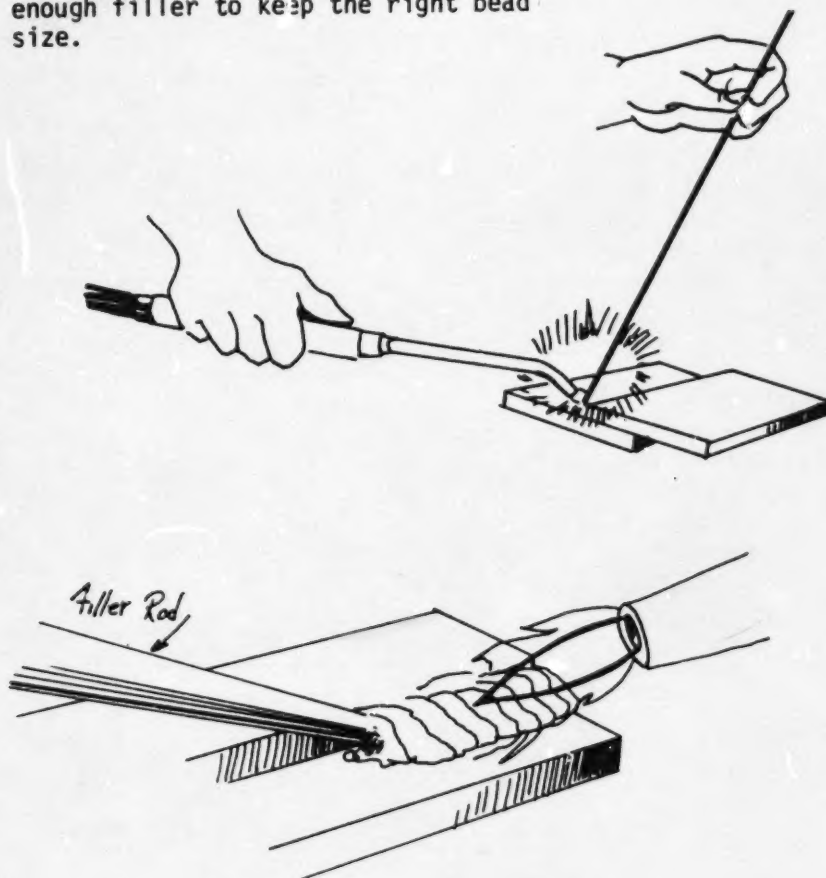
3. Holding the torch at 45°, traveling from right to left, forehand technique, melt the base metal to form a puddle before you add the filler rod.



4. Place the filler rod in the leading edge of the puddle at a 45° angle, 1/16" from the cone of the flame.



5. Moving the puddle right to left, add enough filler to keep the right bead size.



COMPETENCY: Weld with Filler Rod in a Horizontal Position

COURSE: Automotive Body and Fender

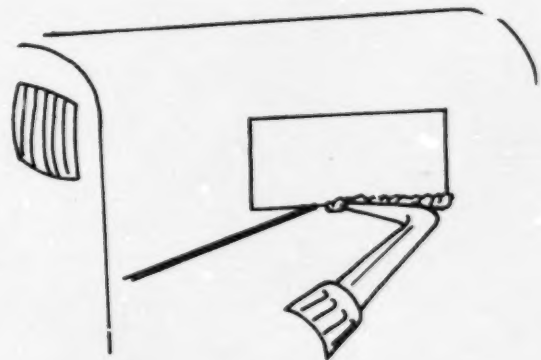
UNIT I: Metal Work

OBJECTIVE: The student will be able to properly weld with filler rod in a horizontal position

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Heat the metal until a puddle has been formed and proceed with the weld by bringing the filler rod in at a 45° angle to the joint and at 90° angle to the torch.
2. Add the filler rod to the welded joint as fast as the metal will puddle, moving along as fast as possible, and using enough filler rod to make a bead $1/4"$ to $3/8"$ wide.



NOTE: At the end of the joint, take care not to "round off" the weld.

COMPETENCY: Weld with Filler Rod in a Vertical Position

COURSE: Automotive Body and Fender

UNIT I: Metal Work

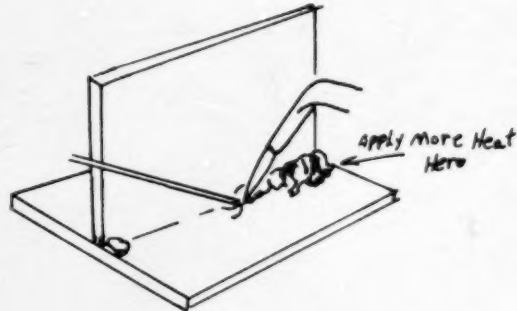
OBJECTIVE: The student will be able to properly weld with filler rod in a vertical position

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Hold the torch at a 45° angle as before, parallel to the joint.
2. Apply more heat to the horizontal piece than to the vertical piece by concentrating the flame on the horizontal piece, right next to the vertical piece.
3. Add filler rod to puddle as needed, moving as fast as the metal will puddle.
4. Weld the reverse side by applying equal heat to both horizontal and vertical pieces and add filler rod as before.



NOTE: Welding the reverse side of the joint may require slightly more heat than needed on the first side.

COMPETENCY: Braze Weld

COURSE: Automotive Body and Fender

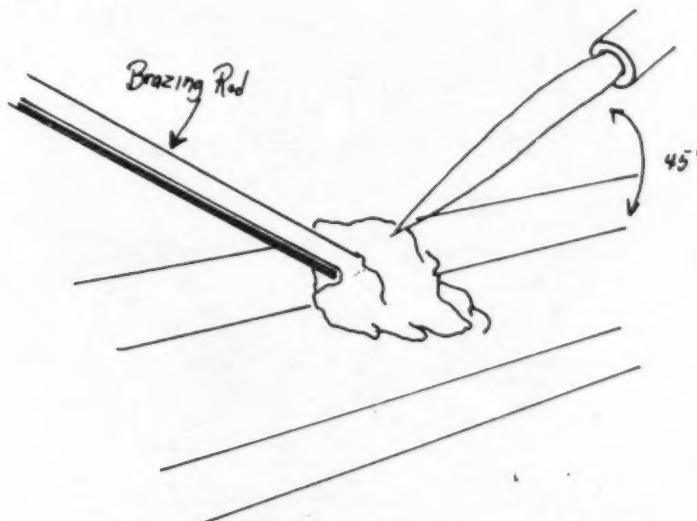
UNIT I: Metal Work

OBJECTIVE: The student will be able to properly braze weld

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Adjust torch to a carbonizing flame.
2. Holding the torch at a 45° angle and parallel to the joint. Heat the spelter rod for a distance of about 2-3" from the end and dip it into the flux to coat it.
3. Holding the torch as described above, heat the metal to a dull red color.
4. Apply the spelter rod to the joint, melting the rod into the joint to form a bead as in welding with a filler rod.



5. Reflux the spelter rod as needed.

NOTE: As with welding, moving too fast will cause loss of joint strength, and moving too slowly will melt the metal instead of simply heating it to the red color. Make sure the rod has enough flux on it at all times.

COMPETENCY: Set Up and Adjust Cutting Equipment

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to properly stop and adjust cutting equipment

Page 1 of 3 pages

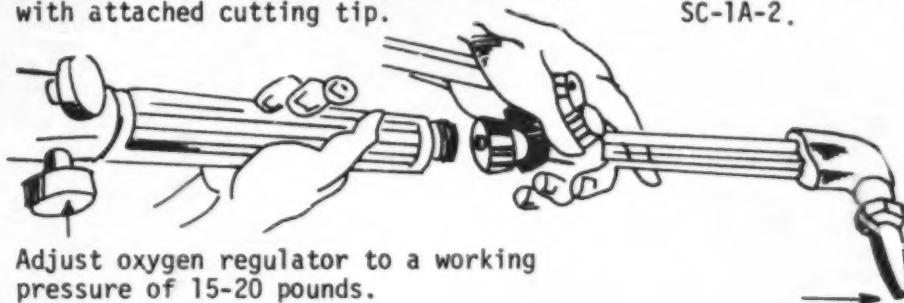
COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

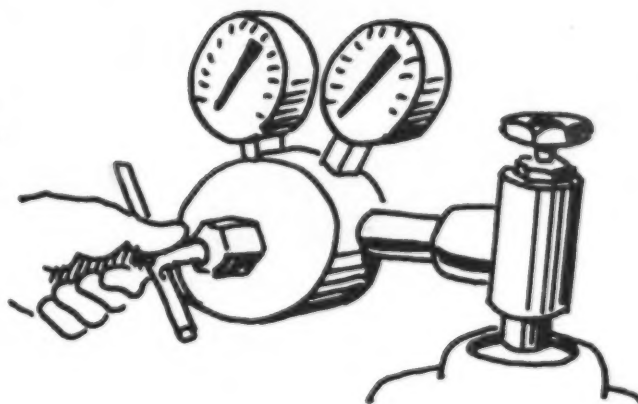
1. Set up equipment as in regular welding with attached cutting tip.

NOTE: Refer to Operation Sheet SC-1A-2.



2. Adjust oxygen regulator to a working pressure of 15-20 pounds.

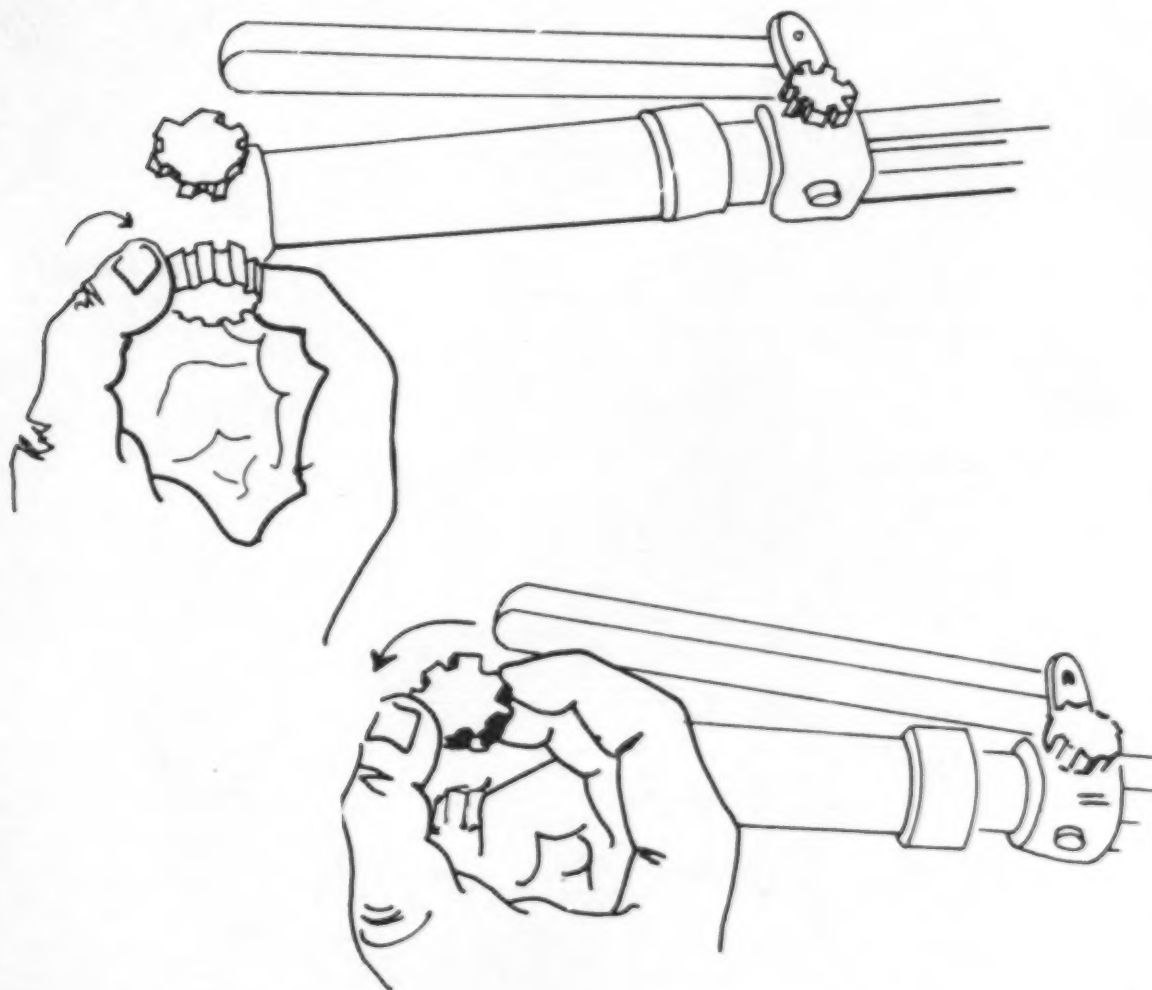
3. Adjust acetylene regulator to a working pressure of 7-10 pounds.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

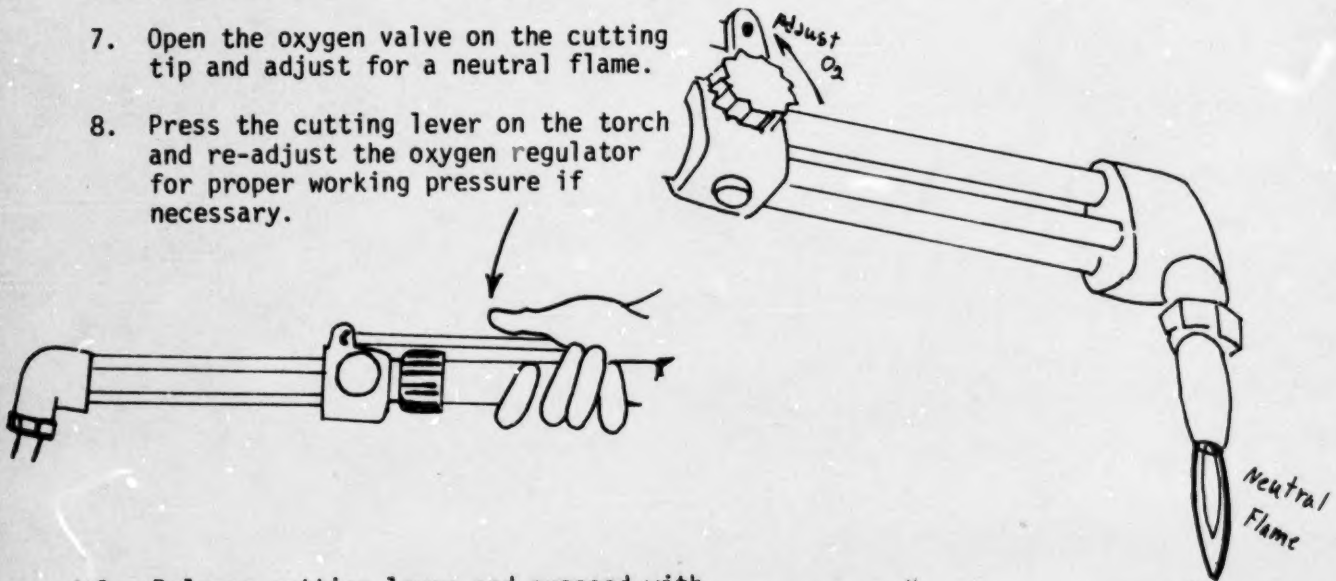
4. Open acetylene valve on cutting torch and spark striker to ignite acetylene.
5. Readjust acetylene cylinder regulator for correct working pressure.
6. Open the oxygen torch valve all the way.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

7. Open the oxygen valve on the cutting tip and adjust for a neutral flame.
8. Press the cutting lever on the torch and re-adjust the oxygen regulator for proper working pressure if necessary.



9. Release cutting lever and proceed with the job.

COMPETENCY: Cut Sheet Metal

COURSE: Automotive Body and Fender

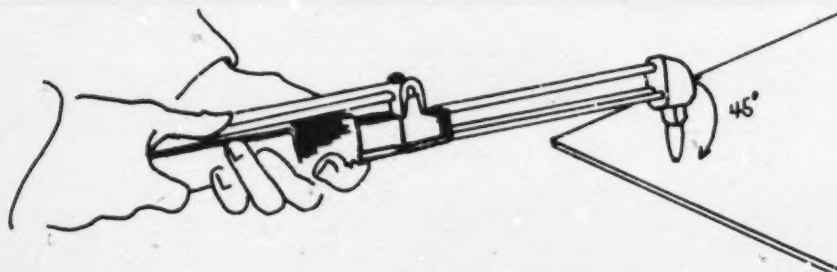
UNIT I: Metal Work

OBJECTIVE: The student will be able to
efficiently cut sheet metal

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Holding the cutting torch at a 45° angle to the work and parallel to the cut to be made, position the cone 1/8" away from the material.
2. Heat the metal to be cut to a cherry red.
3. Press oxygen lever to deliver the oxygen to the cut.



4. Immediately begin moving in the direction to be cut, and move as fast as the metal will cut.

NOTE: If the motion is too fast, the cut will be lost, or if too slow the metal will overheat causing the cut to have a ragged edge and to be wider than necessary.

COMPETENCY: Cut 1/4" and Thicker Plate Metal

COURSE: Automotive Body and Fender

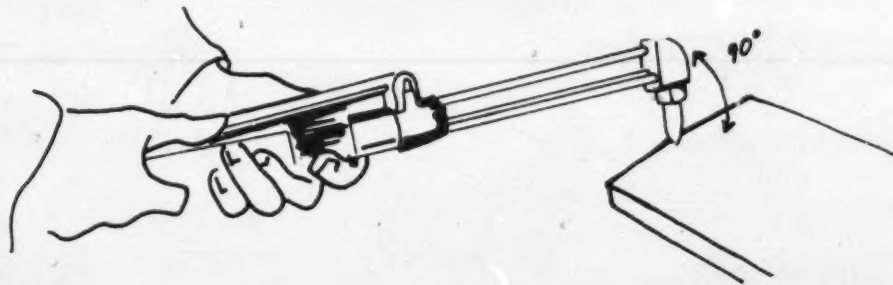
UNIT I: Metal Work

OBJECTIVE: The student will be able to
evenly cut 1/4" and thicker
plate metal

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Hold the torch at 90° angle to the work and parallel to the cut.
2. Preheat the metal to a cherry red color.
3. Press the cutting lever to deliver the oxygen stream.



4. Immediately begin moving the torch in the direction of the cut.

NOTE: Use a slower movement than with sheet metal, since the metal is thicker. Hold the torch perpendicular to the work, or it will cut a bevel on both sides of the cut. Rest the torch on the hand which is not holding the torch to steady the flame and give an even cut.

COMPETENCY: Strike an Arc and Run a Bead

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to run smooth, even and properly formed beads with an electric welder

Page 1 of 2 pages

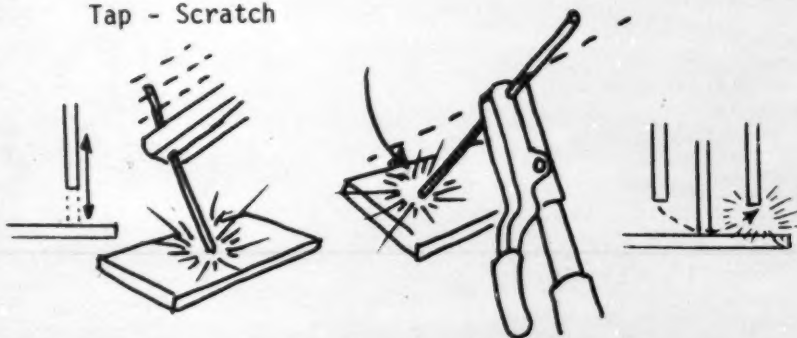
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

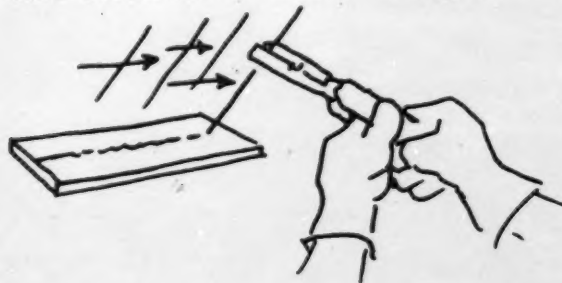
1. Establish the arc on the plane according to method shown:

NOTE: Listen for the arc sound (frying sound)

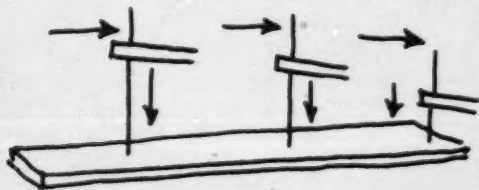
Tap - Scratch



2. Maintain the arc length and begin to move electrode from left to right.



3. Progressing along the plane continually lower rod into the puddle as it is consumed.

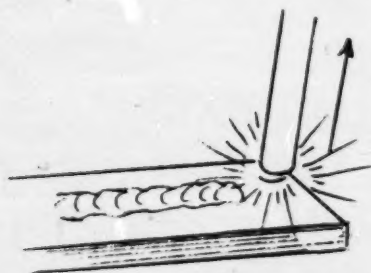


4. Lift rod to stop weld or break the arc.

5. Re-start by striking arc 1" ahead of puddle maintaining long arc to develop the heat needed, and moving back into puddle to continue on with the weld.



6. Complete the weld by reversing the direction of weld slightly to fill crater - or lift rod slowly allowing crater to fill.



METHOD OF EVALUATION:

1. Proper procedure
2. Appearance
3. Safe practices

OPERATION SHEET
SC-1B-2

COMPETENCY: Spot Weld

COURSE: Automotive Body and Fender

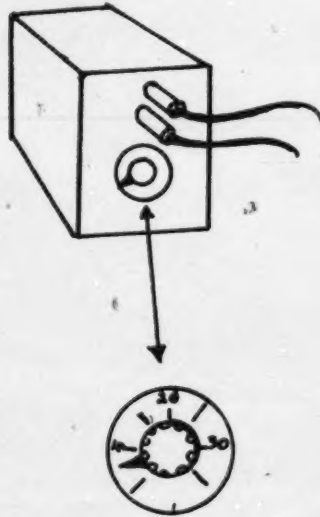
UNIT I: Metal Work

OBJECTIVE: The student will be able to properly fuse sheet metal with the spot welder

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Analyze the job.
2. Select metal, cut to size and secure in place.
3. Adjust welder for proper use.



INTRODUCTION: Spot welding is the method of joining two body panels together by a special spot welder. These panels are joined by a series of spot welds. This method is used to replace or repair sections of automobile panels. This requires little heat and little distortion results on the panels.

NOTE: Metal to be spot welded must be clean and free of paint, rust or filler material.

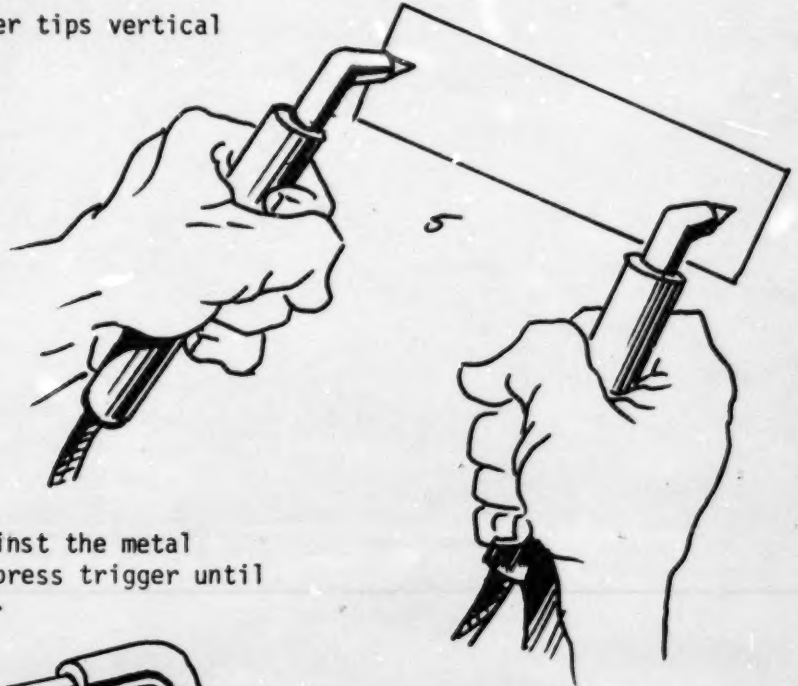
4. Plug in welder.

NOTE: Lower goggles.

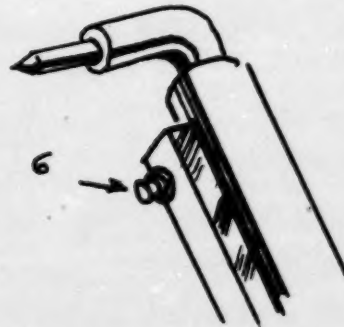
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

5. Hold the spot welder tips vertical to the metal.



6. Apply pressure against the metal with the tips and press trigger until fusion is complete.



7. Repeat steps 5 and 6 until spot welds are completed.
8. Clean up area.

OPERATION SHEET
SC-1C-1

COMPETENCY: Grind with a Portable Electric Disc Grinder

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to grind with portable electric disc grinder

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

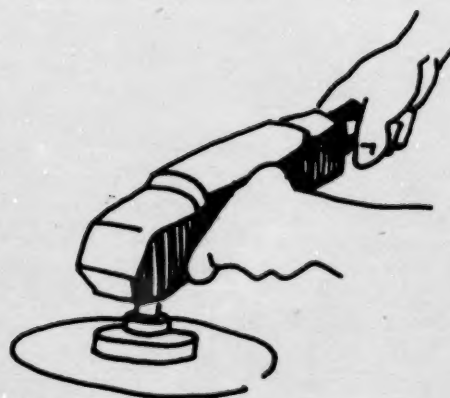
TEACHING/LEARNING ACTIVITIES

1. Stand facing work in a firm, well-balanced position.
2. Grasp machine head with left hand and control end with right hand.



INTRODUCTION: The grinder in the body shop is designed to operate on 110 volts at about 30 amperes, so check circuits to make sure they are adequate for the grinder being used. The grinder is designed so that it can be held firmly and still provide a good grinding action. It is used for removing paint from a damaged area on a panel and for checking progress in roughing out and straightening operations. Be careful not to overheat the panel when grinding, as the panel will distort. Periodic cleaning of the air inlets and outlets is necessary.

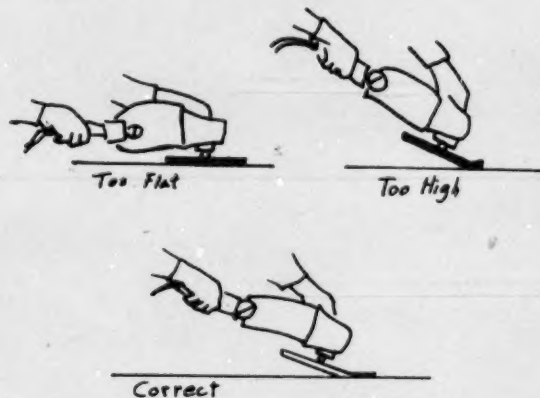
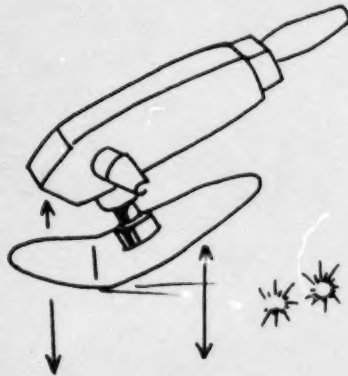
NOTE: Reverse hands for those who are left handed.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

3. Hold disc at 5° angle to work, so 1"-1 3/4" is in contact with machine horizontal.



4. Turning on grinder and applying disc to work, move grinder horizontally across work, using only enough pressure to clean the area.

NOTE: Skill needs to be developed in speed of movement. Too rapid a movement will gouge metal; too slow a movement will overheat and distort metal.



5. Turn off machine, keeping disc on work until machine stops.

COMPETENCY: Trim the Grinding Disc

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to trim the grinding disc

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

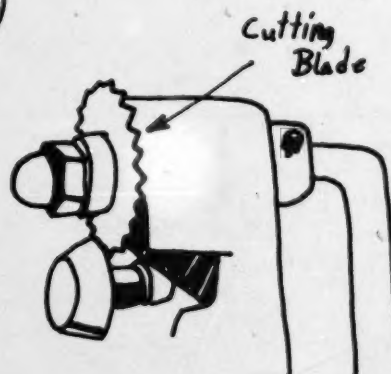
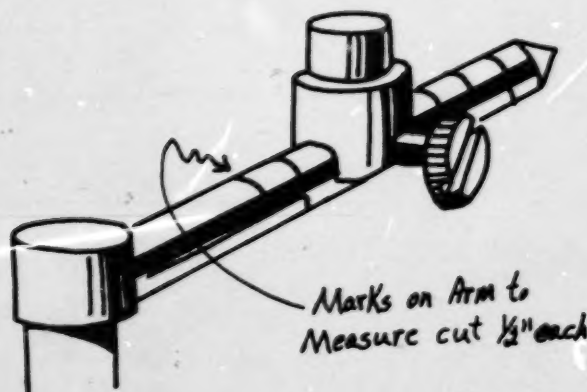
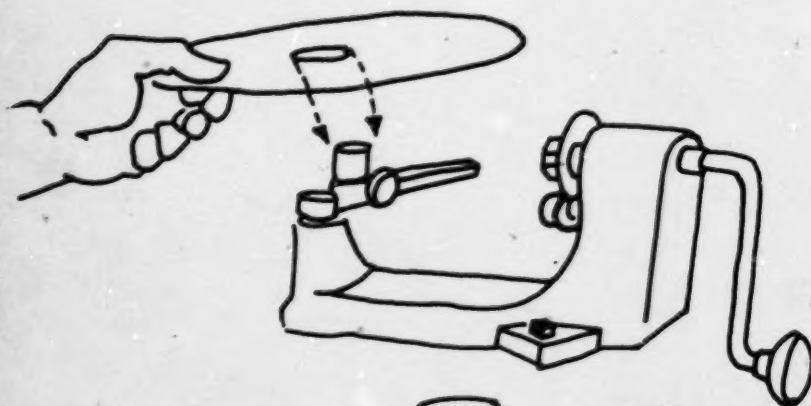
TEACHING/LEARNING ACTIVITIES

1. Insert disc grit down into machine and adjust machine to proper size so as to trim off any work or non-usable part of disc.

INTRODUCTION: Trimming the grinding disc is essential for proper operation of the machine. If the disc is too small and badly worn, the backing plate will rotate against the panel, causing damage to both the panel and the backing plate. If the disc is too large, it will not cut effectively because of lack of back-up by the backing plate or disc. Proper trimming can best be done with a trimming machine. Be careful of the rollers and cutting wheel when trimming, as they can easily be damaged.

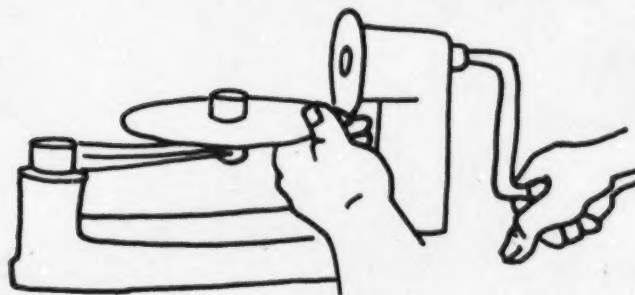
NOTE: Cut disc so that there is at least 1/4" beyond backing plate.

NOTE: Cut disc evenly so that it is balanced. If not cut properly, it will cause a vibration.



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2. Crank machine with hand crank until disc is cut all the way.



COMPETENCY: Prepare Metal Surface for Tinning

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to prepare metal surface for tinning

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Grind surface with #24 open coat disc, removing as much paint and foreign material as possible.



2. Go over the surface again with the rotary wire brush chucked in the electric drill to remove any remaining foreign material.
3. Clean with the smaller scrapers any material remaining in small corners or crevices.
4. Clean areas so they appear shiny like a silver dollar.

INTRODUCTION: Solder will not stick to metal which has not been tinned, and tinning materials will not adhere to dirty base metal. Metal to be tinned must be absolutely clean and free of oxidation and foreign materials.

NOTE: Go over the surface with the mushroom disc.

NOTE: All paint or foreign material must be removed for proper adhesion.

CAUTION: Be careful not to slip when cleaning the area because of bodily injury or damage to the area.

COMPETENCY: Tin Metal for Solder

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to tin metal for solder

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Cover damaged surface with tinning compound, applying the paste with an acid brush in a light-medium coat.
2. Light torch and heat a 3" square surface only until tinning compound changes color.

INTRODUCTION: Solder will not stick to metal which has not been tinned, no matter how clean the metal may be. The tinning materials are designed to increase the ability of the base metal to hold the solder. Without proper tinning, the solder will most likely fall off or peel away in large chunks when it is filed.

NOTE: Don't wipe unheated areas. Rotate rag for clean surfaces.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

3. Repeat until surface is completely tinned.
4. Heat again and wipe away any excess tinning compound or foreign material.

CAUTION: Don't burn oneself or the rag while wiping.

OPERATION SHEET
SC-1C-5

COMPETENCY: Solder Horizontally

COURSE: Automotive Body and Fender

UNIT I: Metal Work

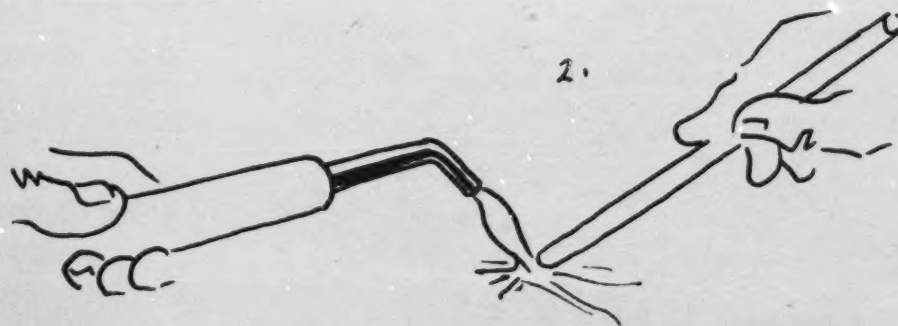
OBJECTIVE: The student will be able to solder horizontally

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Light and adjust torch.
2. Hold torch at 45° in one hand, solder at 45° in other hand.

INTRODUCTION: Soldering is the basic operation used to fill low areas to bring them out to the proper panel contours. Horizontal soldering is relatively easy, since the solder will not tend to run off the surface being soldered. There are special techniques involved in getting the solder to the proper depth and spread properly over the damaged area.



3. Move torch across metal just enough to keep tinning coat hot enough to hold solder.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Rest solder bar on metal then heat solder to melt on metal and add enough solder to adequately fill the depression.
5. Heat beeswax enough to lubricate solder paddle.



6. Move torch over an area until solder is shiny, then smooth to proper contour with paddle.

NOTE: As solder bar shortens hold bar with pliers to avoid burning hands.



7. Add more solder if necessary.

CAUTION: Do not overheat solder, it runs.

OPERATION SHEET

SC-1C-6

COMPETENCY: File and Sand Solder to Contour

COURSE: Automotive Body and Fender

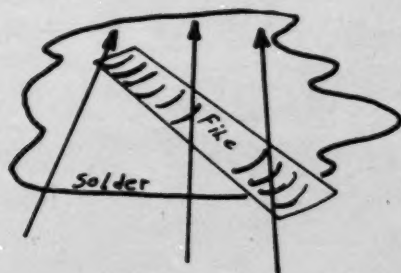
UNIT I: Metal Work

OBJECTIVE: The student will be able to file and sand solder to contour

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Use appropriate body file, shape entire contour by moving file forward and at a 45° angle, and make 4-6 strokes.



INTRODUCTION: Once solder has been applied, it must be shaped to the general contour of the body panel with the body file and sanders, since it is almost impossible to fill a surface to a perfect contour when soldering.

NOTE: Note that the file is not used in a "straight stroke" manner but is used in a "cross-file" manner to produce the desired contours.

2. Continue cross filing by making a 180° turn to form a "t" pattern and complete 4-6 strokes.



3. Fit 80D abrasive paper to sanding block.
4. Cross sand similar to filing to final contour until file scratches are gone.

NOTE: Refill if needed after filing and repeat steps 1 to 4.

COMPETENCY: Solder Vertically

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to solder vertically

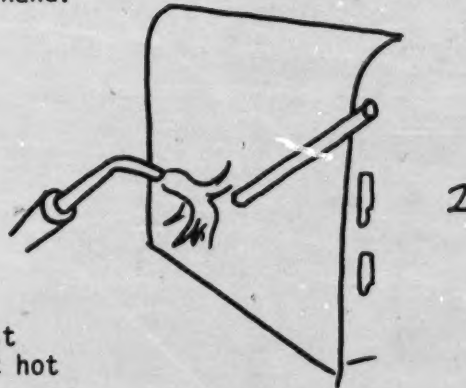
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Light and adjust torch.

INTRODUCTION: Vertical soldering is no different from horizontal soldering as far as the principles are concerned. The only difficulty encountered in vertical soldering is the tendency of the solder to run off the damaged area and fall to the floor. Mastering the technique of keeping the solder on the damaged area and from sagging takes time and practice.

2. Hold torch at 45° in one hand and solder at 45° in the other hand.



3. Move torch across metal just enough to keep tinning coat hot enough to hold solder.

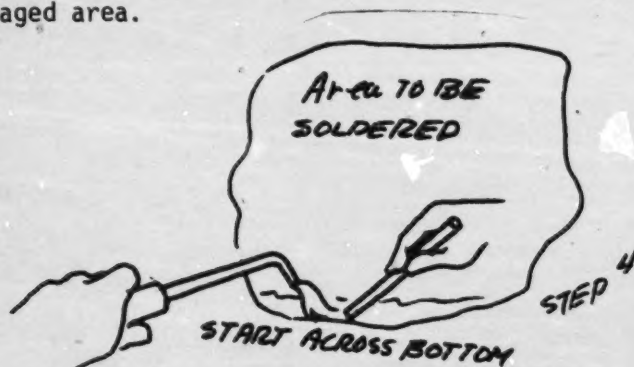


COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Apply solder to metal starting at bottom of area, working back and forth and moving toward the top of the damaged area.

NOTE: Do not overheat solder as it will have a tendency to rag away from the work.



5. Heat beeswax enough to lubricate solder paddle.
6. Move torch over an area until solder is shiny, then smooth to proper contour with paddle.

NOTE: As solder bar shortens hold bar with pliers to avoid burning hands.



7. Add more solder, if necessary.

CAUTION: Do not overheat solder, it runs.

OPERATION SHEET

SC-1C-8

COMPETENCY: Solder Overhead

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to solder overhead

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Light and adjust torch. 2. Hold torch at 45° in one hand, and solder at 45° in other hand. 3. Move torch across metal, keeping tinning coat hot enough to hold solder. 4. Rest solder bar on metal and heat solder to melt on metal, adding enough solder to adequately fill the depression.	INTRODUCTION: Overhead soldering is similar to horizontal soldering as far as the basic principles are concerned, but as with vertical soldering, keeping the solder on the job and off the floor may be a problem. Again, special techniques are used and mastering these techniques will take time and practice.
5. Heat beeswax enough to lubricate solder paddle. 6. Move torch over an area until solder is shiny, then smooth to proper contour with paddle. 7. Add more solder if necessary.	NOTE: Do not get under the job, as hot solder may fall on you. CAUTION: Do not overheat.

COMPETENCY: Fill with Plastic Filler

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to fill with plastic filler

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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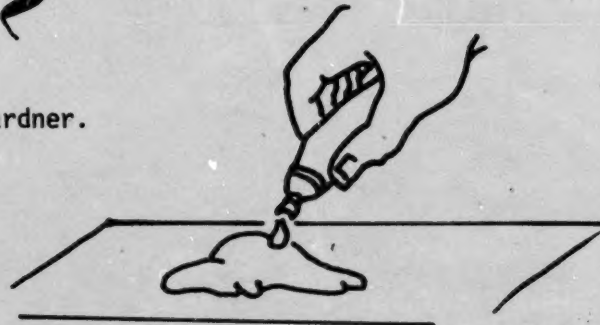
1. Grind metal clean with a No. 24 grit sanding disc and touch up with No. 80 grit production sandpaper.
2. Clean about six inches on all sides of area to be filled to allow for contour adjustment to the original panel.
3. Remove enough plastic from can to make repairs or fill and place on glass.

INTRODUCTION: Plastic body filler is an alternative method of filling depressions in a damaged panel. It can be, in some cases, quicker and more convenient than soldering, but it is not necessarily the best method in all cases. Good judgment is required to determine which method to use.

NOTE: Thoroughly read the manufacturer's directions for mixing proportions. Each manufacturer will vary slightly.



4. Add correct amount of hardner.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

5. Use a putty knife and a piece of glass, mix the plastic and hardner thoroughly.



6. Apply plastic with the proper size spreader to the prepared surface.
7. Press and spread the mixture firmly onto the surface working it out smoothly to proper contours.



OPERATION SHEET
SC-1C-10

COMPETENCY: Prepare and Apply Fiberglass

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to prepare and apply fiberglass

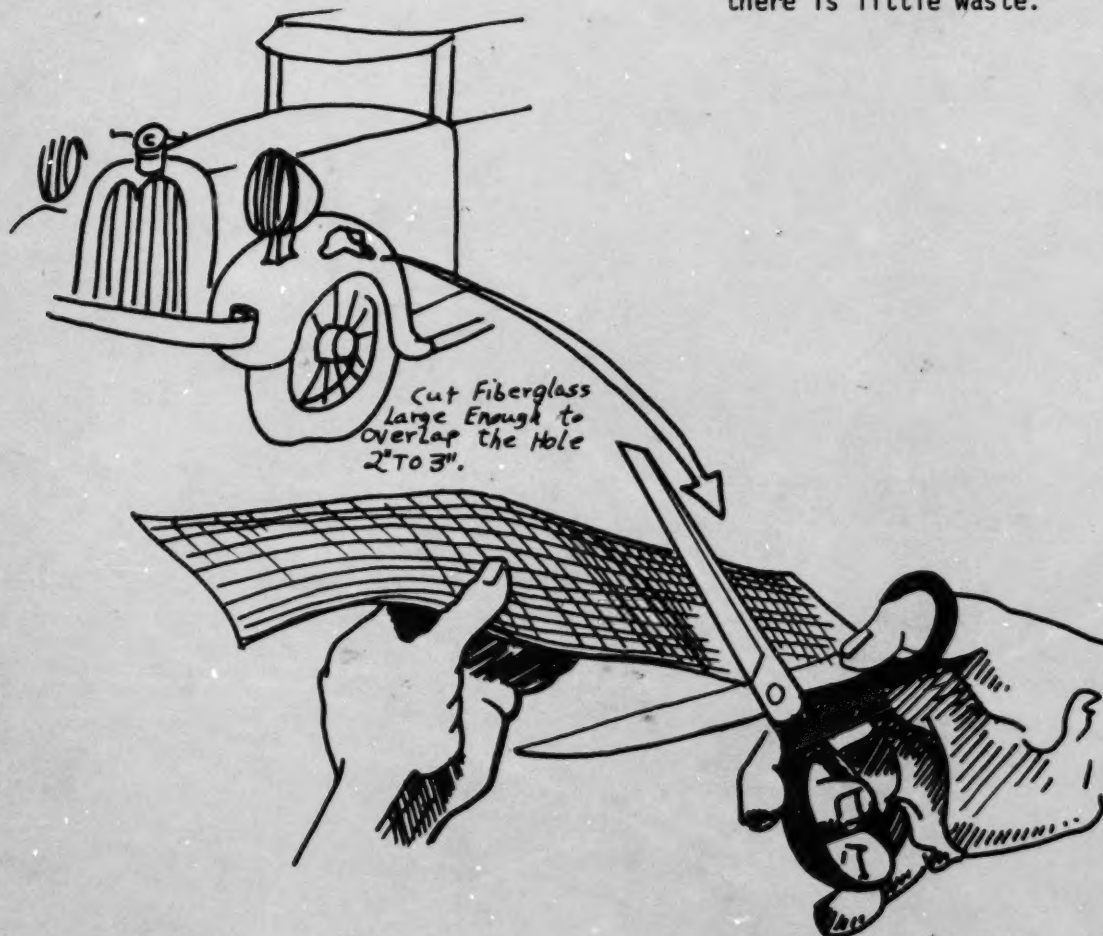
Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Cut the fiberglass cloth with scissors.

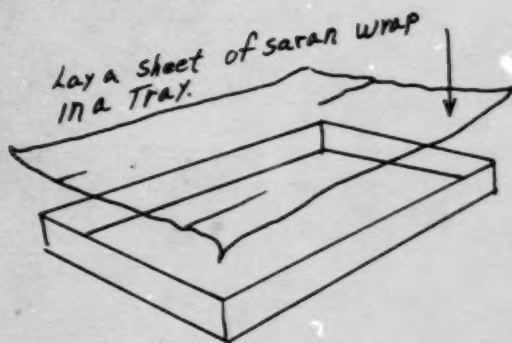
INTRODUCTION: Fiberglass patching is fast and does a good job. In many cases, fiberglass patching is less expensive than other methods. If it is done correctly, there is little waste.



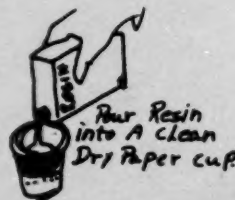
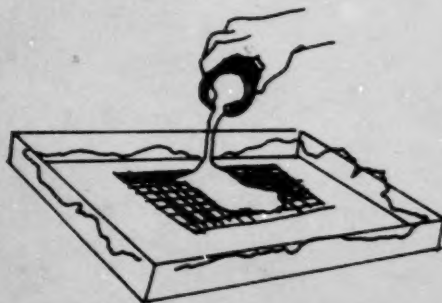
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

2. Lay the fiberglass on a sheet of polyethylene (Saran Wrap) on the metal tray.



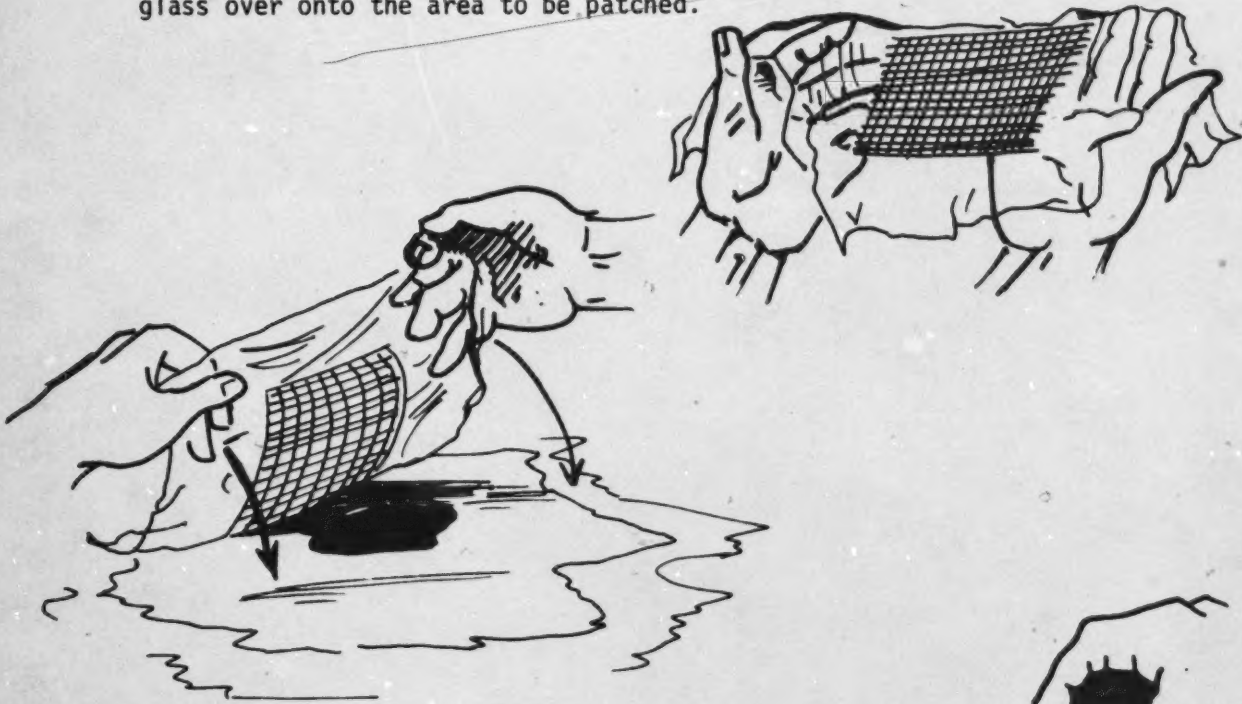
3. Pour the prepared resin and hardener over the cloth, spreading it with the plastic applicator or a brush.



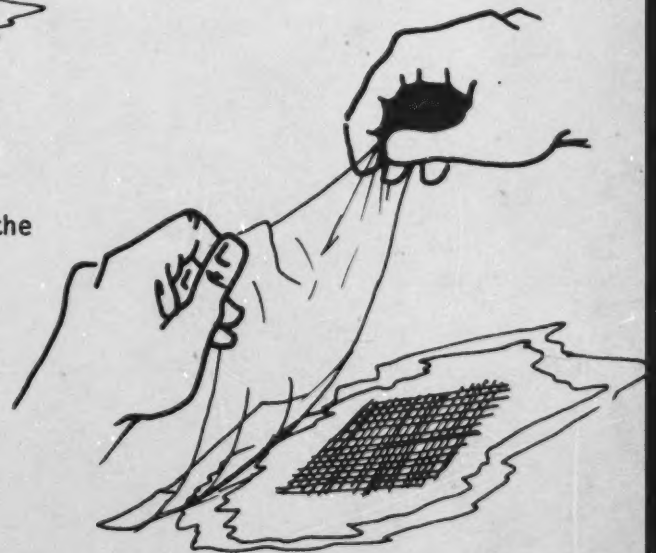
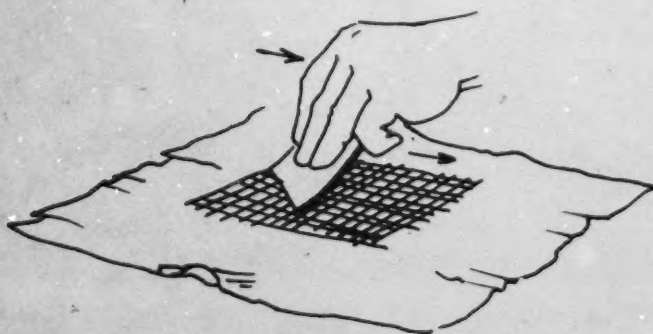
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Turn the sheet over and repeat Step 3.
5. Lift the saturated fiberglass sheet with the polyethylene sheet and turn the fiberglass over onto the area to be patched.



6. Remove air bubbles by smoothing with the plastic applicator.



OPERATION SHEET
SC-1D-1

COMPETENCY: Use a Dolly and Hammers

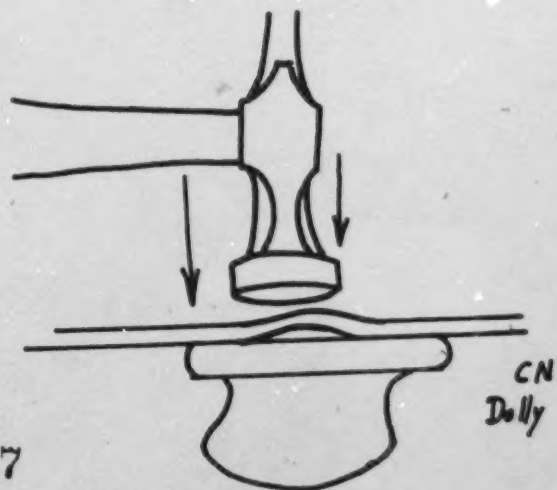
COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use a dolly and hammers

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Hold dolly in left hand and hammers in right hand. 2. Rough out the damaged area by using the dolly as a hammer; and beginning with the perimeter, work to the center using many light blows rather than a few heavy blows.	INTRODUCTION: The dolly block and the body hammer are the two basic tools of the bodyman for roughing and straightening damaged sheet metal. The proper use of the dolly block and hammers will ensure a relatively smooth, well-contoured surface which will require a minimum of filling to be perfectly smooth. There are a variety of techniques used when roughing out with the hammers and dolly blocks, and each must be learned separately to be mastered.
3. Finish by holding dolly against underside like an anvil with only enough pressure to absorb hammer blow and strike lightly with the hammer.	NOTE: When using dolly as picking tool, use only the corner of the dolly.

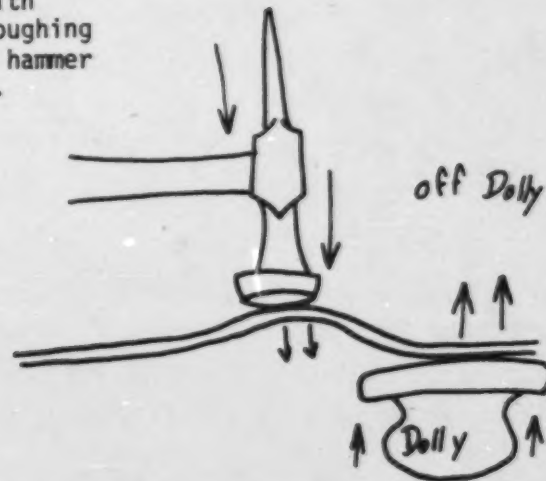


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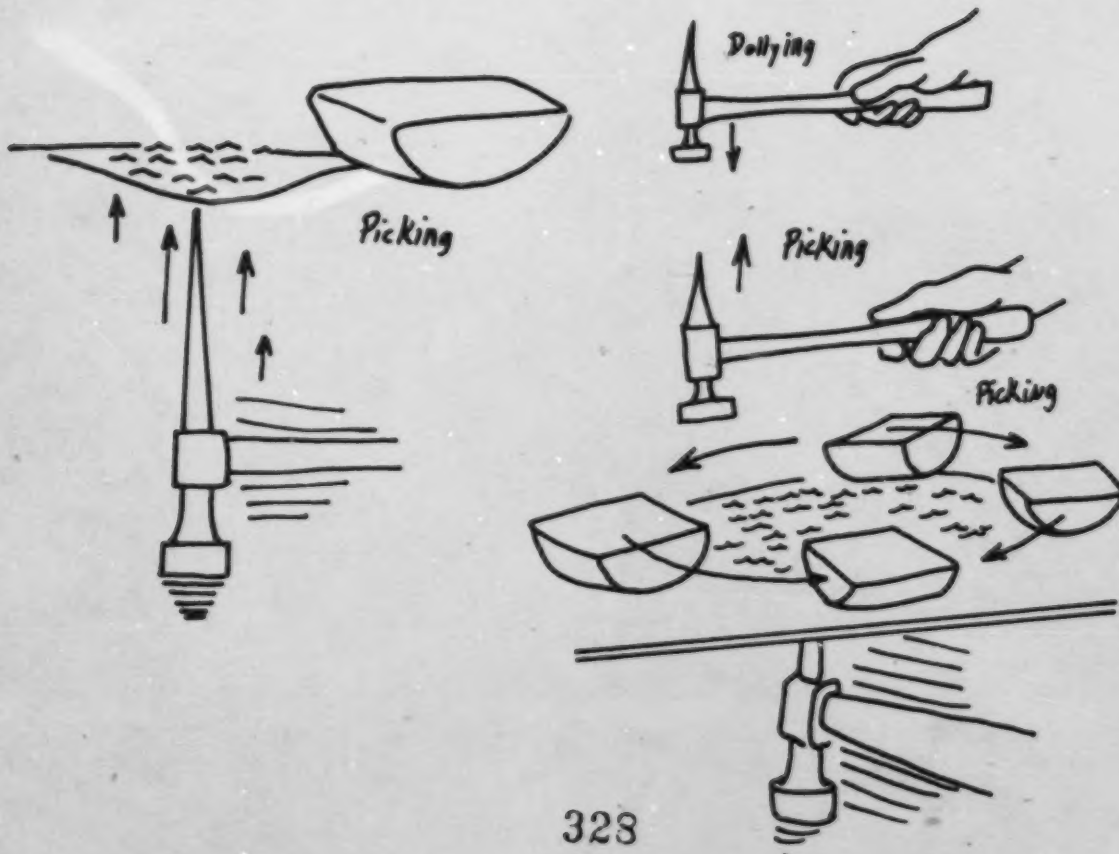
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Rough out by swinging hammer with wrist, fingers and elbow for roughing out; bump down high spots with hammer and raise low spots with dolly.



5. Finish by hammering short 4"-6" strokes with wrist-finger action only.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Hammer on underside to bring up low spots.
7. Use ball peen hammers for spring hammering with a spoon between metal and hammer for ridges, etc.

COMPETENCY: Shrink Sheet Metal

COURSE: Automotive Body and Fender

UNIT I: Metal Work

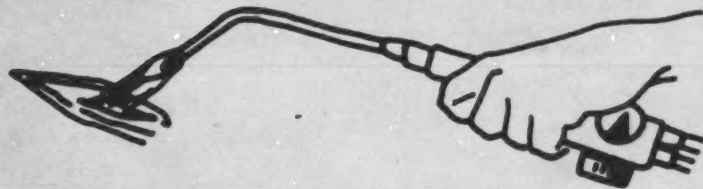
OBJECTIVE: The student will be able to shrink metal

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

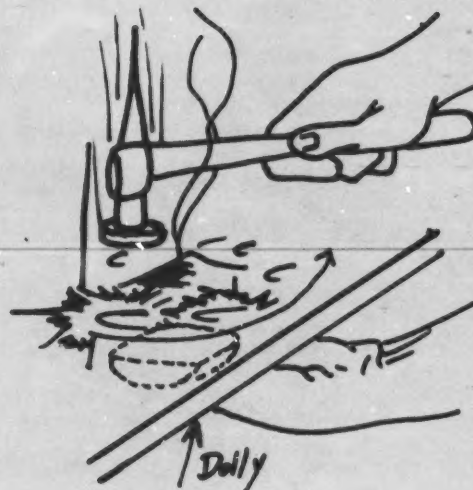
TEACHING/LEARNING ACTIVITIES

1. Locate the highest point in the stretched section of the panel and heat the size of a nickel to cherry red, using a circular motion of the torch.



INTRODUCTION: In the process of straightening and roughing out sheet metal, it often becomes stretched, or it may be stretched as a result of the damage itself. In these cases, it must be shrunk slightly to restore it to proper contours. By using the techniques outlined below, sheet metal can actually be shrunk enough to take up "slack" in the panel and restore it to proper contours.

2. Place a flat-faced dolly under the hot spot.
3. Strike the hot spot 4-6 times with short, glancing blows, starting at perimeter and working towards the center.



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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Quench the hot spot with a waterfilled sponge.



5. Repeat steps 1-4 until done.

NOTE: If over-shrunk, re-heat the area the size of a nickel; hold dolly on the underside of heated area applying outward pressure and quench with wet sponge.

COMPETENCY: Use Pick Bars

COURSE: Automotive Body and Fender

UNIT I: Metal Work

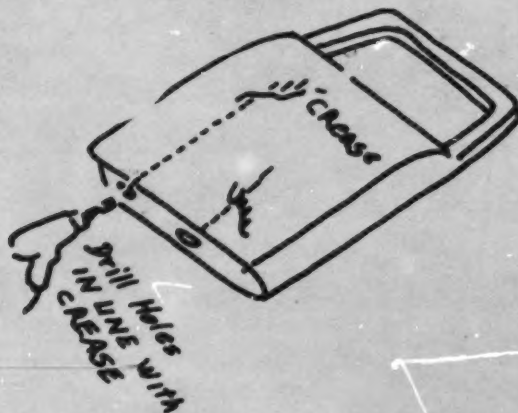
OBJECTIVE: The student will be able to use pick bars

Page 1 of 2 pages

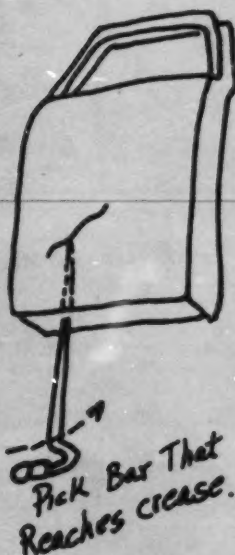
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Drill appropriate size holes in proper locations for inserting pick bars.

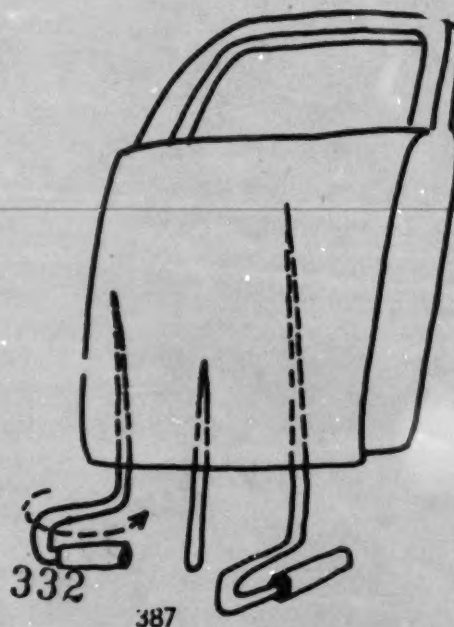


2. Insert pick bar, working around the perimeter of damaged area, applying medium pressure on bar.



INTRODUCTION: The pick bar is used to get in behind surfaces or panels where it would be impossible, time-consuming or destructive to remove inner panel and upholstery work. The pick bar can be inserted through a relatively small hole on the edge of the panel and brought to bear against the damaged area, prying the damaged area out to approximate contours. Proper use of the pick bar will result in less filling than might otherwise be necessary. It is a substitute for the dolly block and body hammer.

NOTE: Too much pressure on the bar will cause a high area at point of contact and the spot might be filed through.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

3. Repeat step 2 on perimeter, working toward center of damaged area.
4. File area to determine progress.
5. Repeat steps 3 and 4 until operation is completed.

OPERATION SHEET
SC-1D-4

COMPETENCY: Use a Caulking Iron

COURSE: Automotive Body and Fender

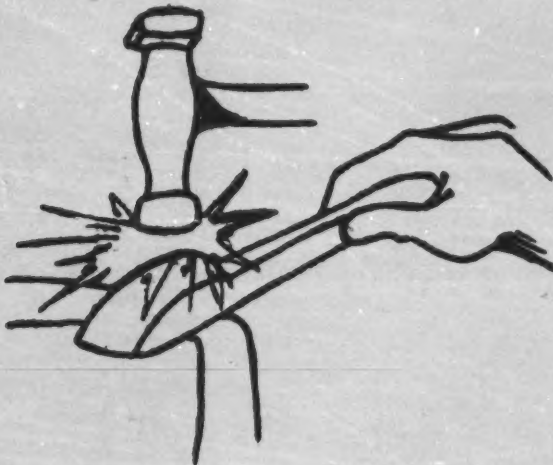
UNIT I: Metal Work

OBJECTIVE: The student will be able to use caulking iron

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

1. Insert caulking iron into damaged area.
2. Strike end of iron using light blows with body hammer, taking care not to penetrate metal.
3. Work around damage until properly roughed out.



TEACHING/LEARNING ACTIVITIES

INTRODUCTION: The caulking iron is used as a substitute for a dolly block for tight or hard-to-reach areas on a panel, such as a lip over the headlamp. The design of the tool permits it to be used without puncturing the metal.

NOTE: It may be necessary to use the oxy-acetylene torch to heat the metal for working.

OPERATION SHEET
SC-1D-5

COMPETENCY: Use Body Spoons

COURSE: Automotive Body and Fender

UNIT I: Metal Work

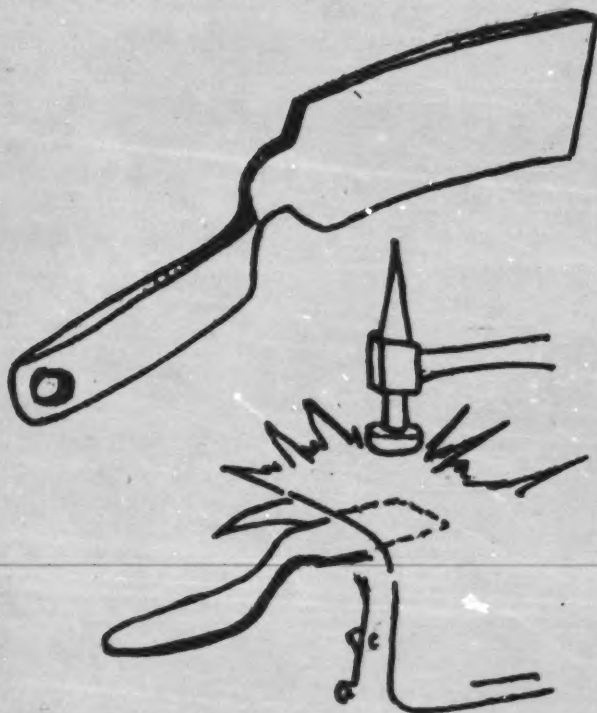
OBJECTIVE: The student will be able to use body spoons

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Select proper body spoon for operation.
2. Insert spoon on underside of damaged area and use as a pry bar or dolly block to rough out damage.
3. Use hammer with spoon to "unlock" pressure points and high spots.

INTRODUCTION: Body spoons are used on the underside of panels as substitutes for dolly blocks or as pry bars. It is designed for use in areas where access with a dolly block is impossible because of inner panels.



COMPETENCY: Use Hand and Power Panel Cutters

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use hand and power panel cutters

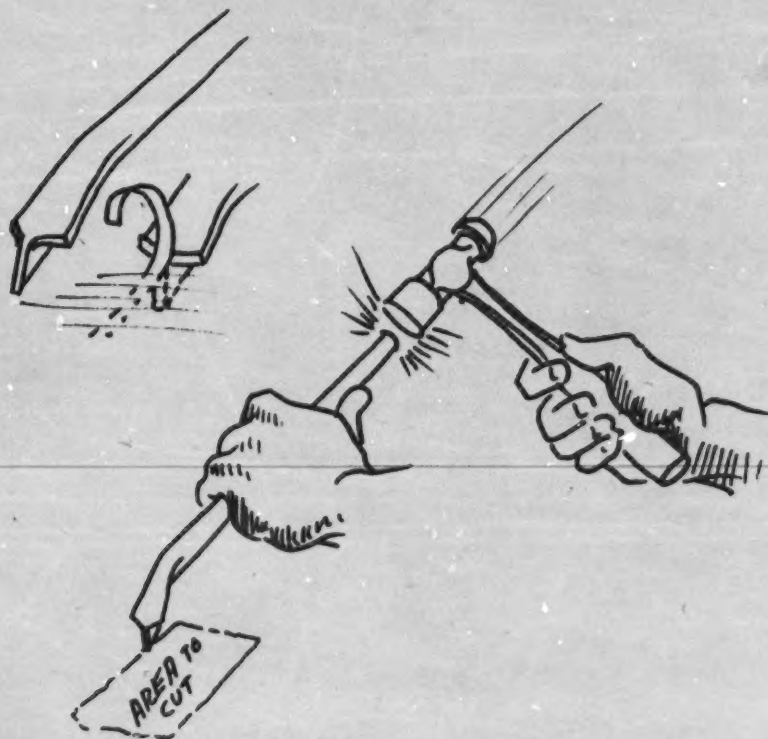
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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A. Hand Cutter

1. Outline area to be cut with chalk.
2. Hold panel cutter in left hand at 45° to the work, parallel to the line of the cut.
3. Hold hammer in right hand and strike cutting tool using light-medium blows to start and continue the cut.

INTRODUCTION: There are times when repair of a section of a panel is impractical or impossible, or when a panel has to be cut free in order to be replaced. In these circumstances, it is necessary to use hand or power panel cutters to remove a section of the panel or the entire panel. They should be handled with extreme care.



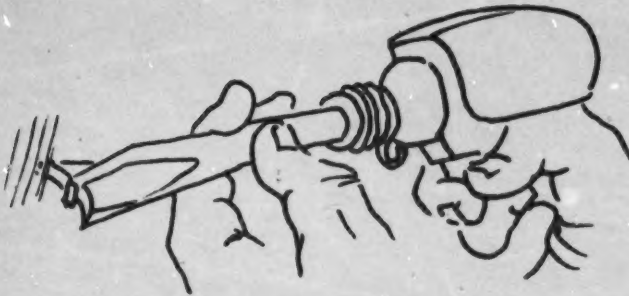
336

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

B. Power Cutter:

1. Hold cutter in the right hand at 45° to the work and parallel to the cut and using left hand guide the tool.
2. Squeeze trigger on cutter to start the cut and follow the chalk outline to complete the cut, using a slight up-and-down motion.
3. Hold cutting blades firmly in the hand to prevent damage to the vehicle or injury to a fellow worker.



OPERATION SHEET
SC-ID-7

COMPETENCY: Slap Sheet Metal

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to slap sheet metal

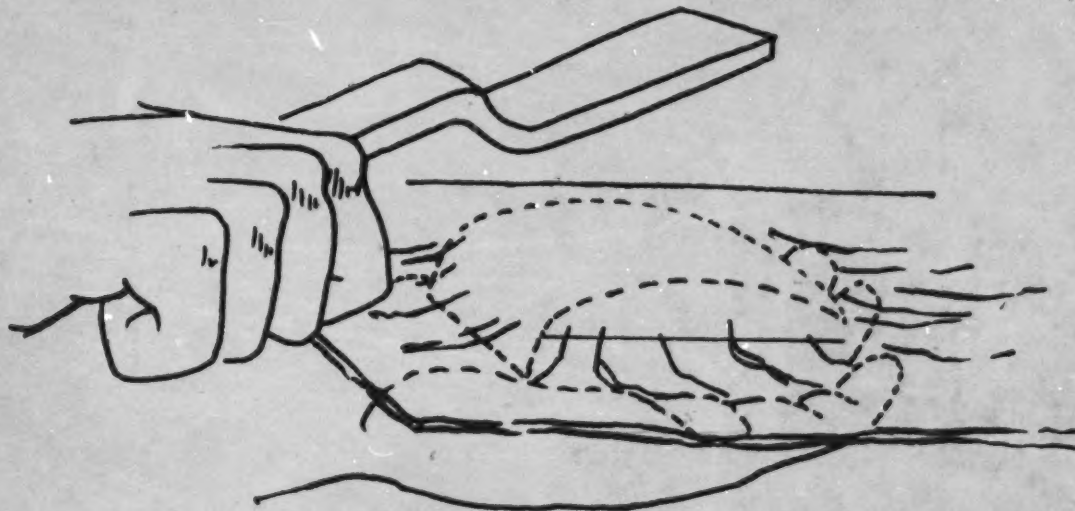
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Hold dolly in one hand against underside of damaged area, applying pressure with the dolly.
2. Hold slapper in other hand and strike the damaged area with glancing light-to-medium blows.

INTRODUCTION: The slapper is used in metal finishing as a substitute for the body hammer. The slapper covers a larger area than the body hammer which can be an advantage in certain cases. This tool is used with light, glancing blows to prevent metal distortion. It is available in both flat and half-round shapes.



3. Check progress with body file and repeat step 2 if necessary.

COMPETENCY: Repair a Concave Surface

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to repair a concave surface

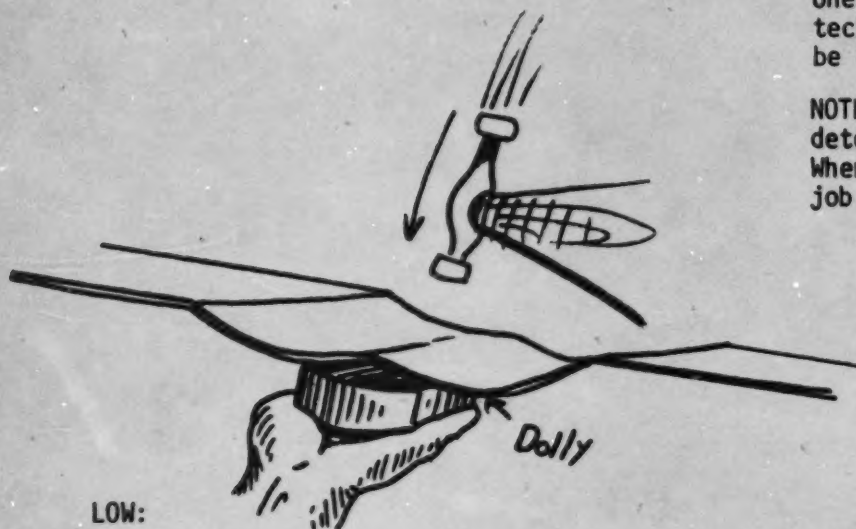
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

HIGH:

1. Use appropriate dolly as an anvil on underside and use concave body hammer or dolly and work to contour.
2. Use either hammer or slapper to strike surface with dolly to remove imperfection.



LOW:

3. Use appropriate dolly as a hammer on underside and dolly on top as anvil.

INTRODUCTION: There are two general shapes of surfaces other than the flat surface which the bodyman is called on to repair. They are the convex and the concave surface. The concave surface is one in which the edges of the surface are closer to oneself than the center. The techniques described below can be used to repair a concave surface.

NOTE: Cross file periodically to determine degree of progress. When low areas are alright, the job is done.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

4. Repeat step #2.
5. Grind with #24 disc and finish with 50D.

OPERATION SHEET

SC-1D-9

COMPETENCY: Repair a Convex Surface

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to repair a convex surface

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Use appropriate dolly, bump damaged metal area upward or outward to approximate contour.
2. Place dolly against center of low spot on underside of panel and apply pressure.
3. Strike high spots around the dolly with hammer or slapper to remove imperfections.



INTRODUCTION: Various types of surfaces must be repaired in body and fender work, such as flat, concave and convex. A convex surface is one in which the edges of the surface are farther away from oneself than the center. This type of surface requires special techniques for proper repair.

4. Cross file periodically to determine degree of progress.

NOTE: The beginning students must develop the "art" of detecting high and low spots in metal by touch, using full hand and then cross-filing metal to check judgment.

5. Grind with a #24 open coat disc and finish with #50D production paper.

COMPETENCY: Repair an Oil Can Effect

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to repair an oil can effect

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

APPROACH #1

1. Determine the pivot point of an oil can by flexing the metal.
2. Hold dolly firmly under the pivot point.
3. Tap around the perimeter of the low spot with a pick hammer until panel retains rigidity.

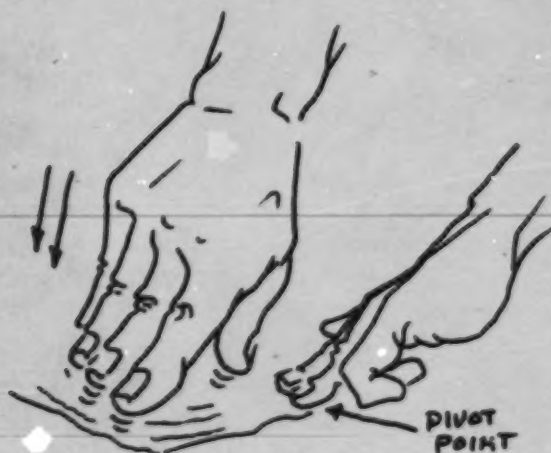
NOTE: Shrinking may be necessary but must be done cautiously.

4. Use hammer or slapper with a dolly, work area to proper contour.

NOTE: Check progress by feeling and cross-filing.

5. Grind with #24 open coat disc and finish with #500 production paper.

INTRODUCTION: An "oil can" is an effect created by stretched metal and will most likely occur on flat panels. The metal flexes in and out just as the bottom of an oil can does, and will not remain rigid in any position.



PUSH SURFACE UP AND DOWN
with one hand. Feel for
Pivot Point with other hand.



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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

APPROACH #2

1. Determine pivot point, clean, tin and solder an appropriate size area over the pivot point. Allow to cool.
2. Hold dolly firmly under the pivot point.
3. Tap around the perimeter of the low spot with a pick hammer until panel retains rigidity.
4. Use hammer or slapper with a dolly, work area to proper contour, repeating until finished.
5. Grind with #24 open coat disc and finish with #50D production paper.

NOTE: Check progress by feeling and cross-filing.

OPERATION SHEET
SC-1D-11

COMPETENCY: Use Suction Cups

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use suction cups

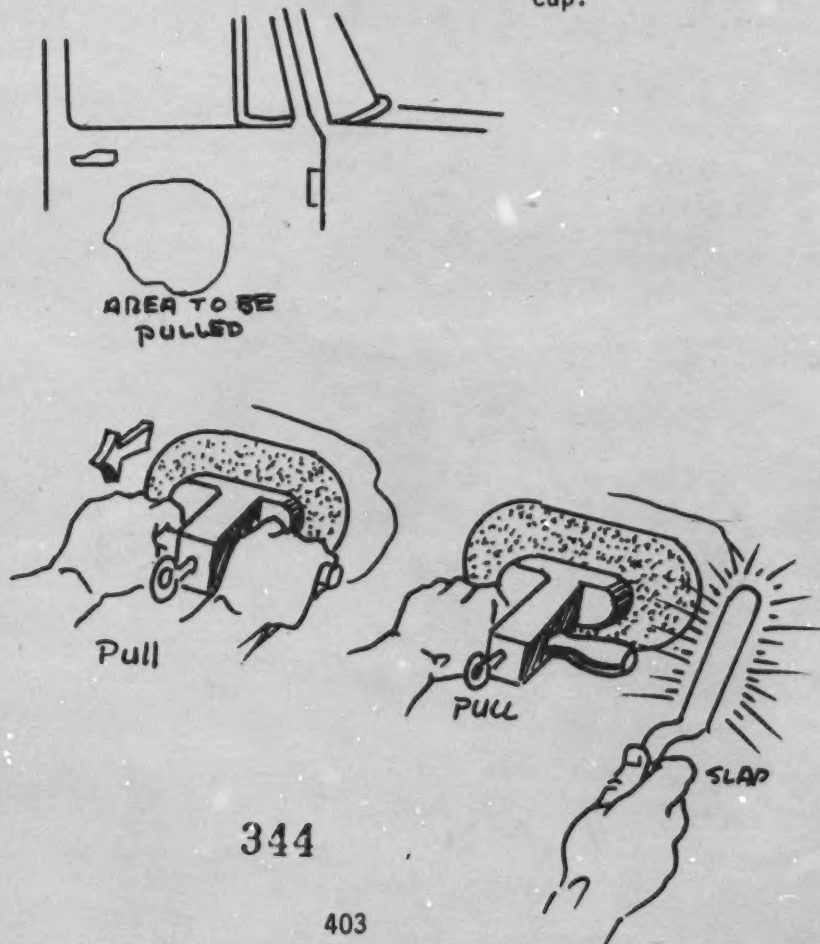
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Place suction cup on concave area.
2. Pull outward on suction cup, spring hammer the perimeter of concave area with body hammer or slapper.
3. Repeat procedure until panel is finished to original contour.

INTRODUCTION: Suction cups are well-suited for pulling large or small dents out of panels without having to get the the underside of the panel. They can be used where a slide hammer might be impractical or unnecessary.

NOTE: Take a firm well-balanced stance when pulling on suction cup.



OPERATION SHEET

SC-1D-12

COMPETENCY: Use Slide Hammers

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use slide hammers

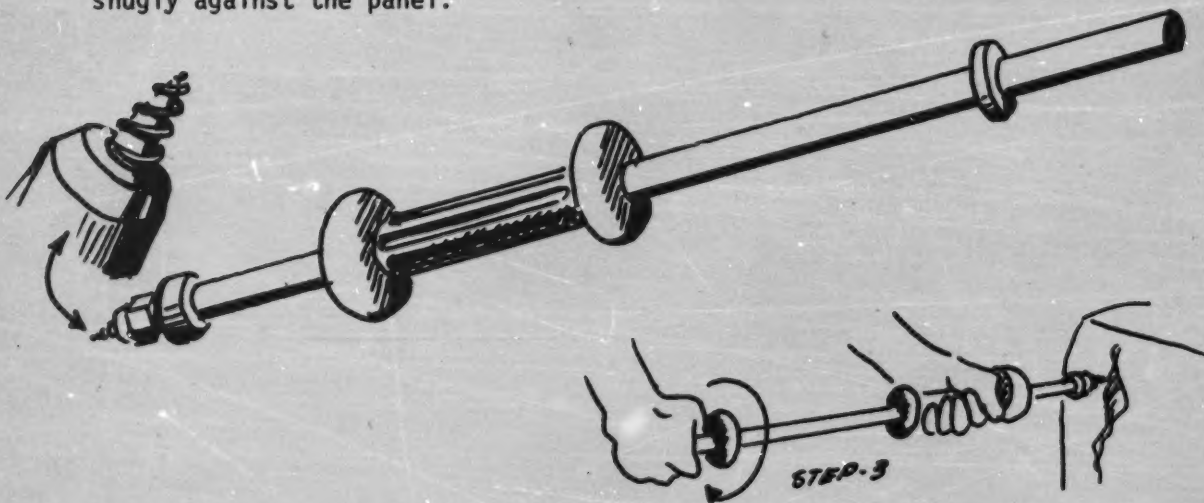
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

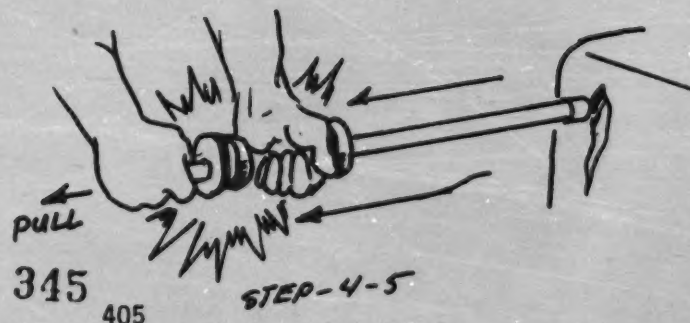
TEACHING/LEARNING ACTIVITIES

1. Locate the low section of the body panel crease.
2. Select a 1" square area near the edge of the crease and punch or drill a hole in the center of the area.
3. Thread the sheet metal screw of the slide hammer into the hole punches in step #2 by turning the entire slide hammer, until the slide hammer fits snugly against the panel.

INTRODUCTION: The slide hammer is used to remove creases in a body panel without disturbing and/or removing upholstery head liners or body hardware. This tool may be used on all types of panels without removal of inner panels.



4. Hold the free end of the slide hammer in one hand, pulling lightly away from the panel.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

5. Using the other hand, slide the hammer on the slide against the handle stop with only enough force to bring the panel section out to the desired contour.

6. Punch a second hole about an inch away from the first and repeat steps 3 and 5 as needed.

COMPETENCY: Apply Tension Plates

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to apply tension plates

Page 1 of 1 page

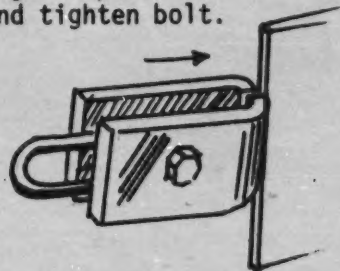
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Use clamp-on plates, open clamp.

NOTE: Check to see that the teeth on the clamp are clean.

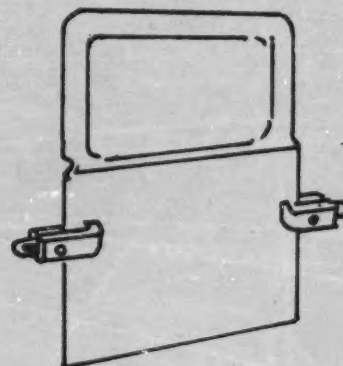
2. Insert clamp over edge of panel at appropriate place and tighten bolt.



STEP #2

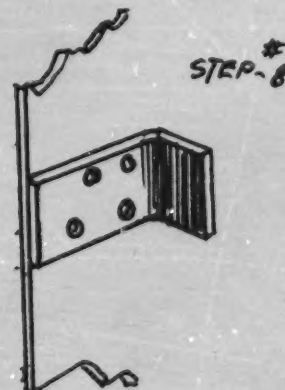
3. Use solder clamps--grind area where clamp will be placed free of paint.
4. Tin a 6" x 6" area on which to place solder plate.

INTRODUCTION: Tension plates are designed to grip the edges of a panel or be fastened to the panel with solder. It is often a necessary step in a straightening/roughing-out situation, before using a porto-power unit. Plates must be clean and firmly attached to avoid slippage.



NOTE: Check to see that plate is tinned properly.

5. Apply solder over area on which clamp will be placed.
6. Press plate into place at correct angle while solder is still hot.
7. Heat plate until solder melts into the holes in the plate; allow to cool.



STEP #8

COMPETENCY: Use Adapters and Heads for Porto-Powers

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use adapters and heads for porto-powers

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

TENSION PLATES:

1. Select proper extensions.
2. Attach one extension to the ram head and the other to the heel of the ram.
3. Attach extensions to tension plates by tightening set screws or inserting pins.

DOOR OPENING CORRECTION:

1. Select proper extensions.
2. Attach adapter or short extension to ram head, as needed.
3. Attach longer extension to heel of ram.
4. Attach rubber heads to both ends.

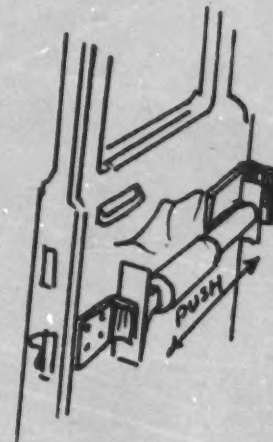
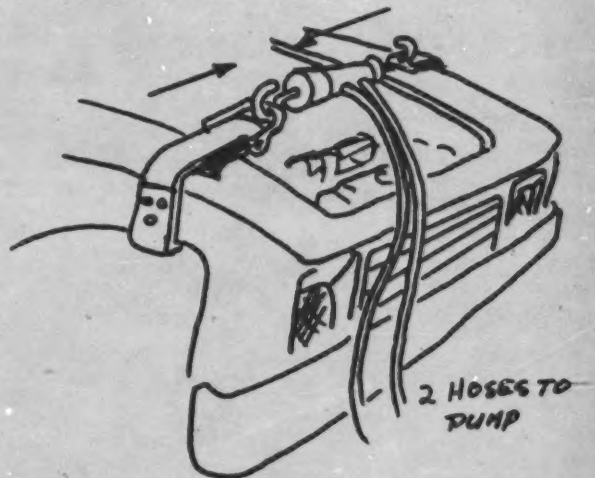
NOTE: If metal heads are used, use wood blocks for cushioning.

5. Insert appropriate heads and extensions for bracing purposes.

PULLING OPERATION: (Front end sheet metal alignment)

1. Select proper extensions.
2. Extend ram to full length.
3. Attach extensions to heel and head of ram.
4. Attach nylon straps with appropriate clamp to fender bead.
5. Attach extension to nylon straps.

INTRODUCTION: Porto-power may be used with a variety of heads and adapters to straighten panels, door frames and window frames. Each head or adapter has its own function, and proper attachments must be used to do a job correctly and prevent injury to equipment or students.



COMPETENCY: Use Porto-Powers

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use porto-powers

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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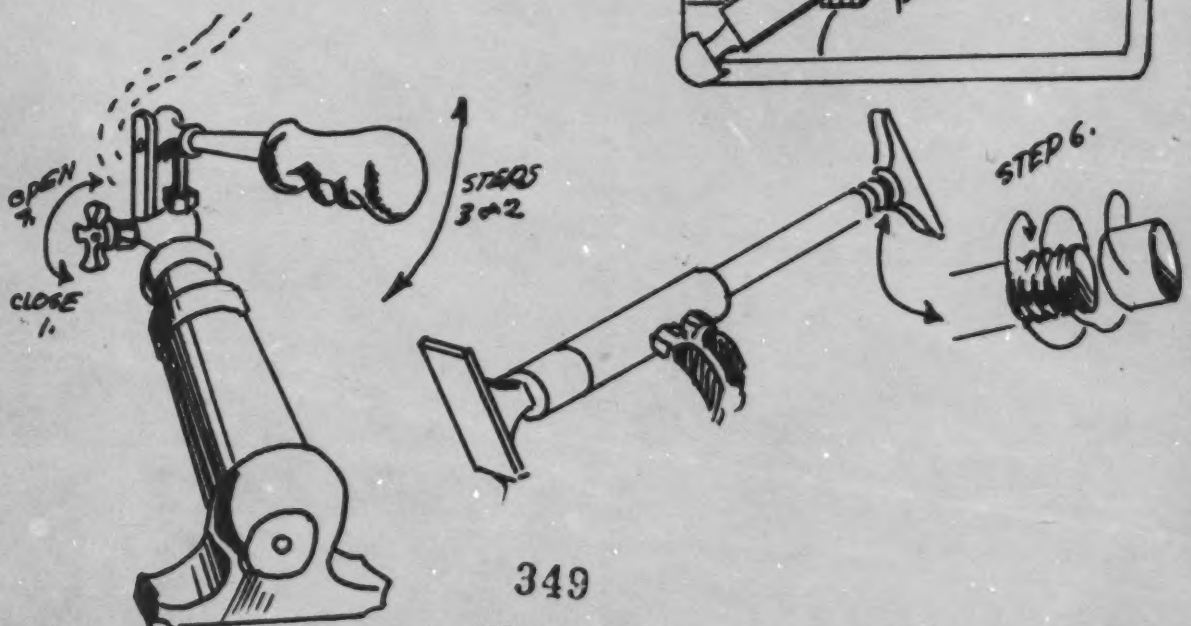
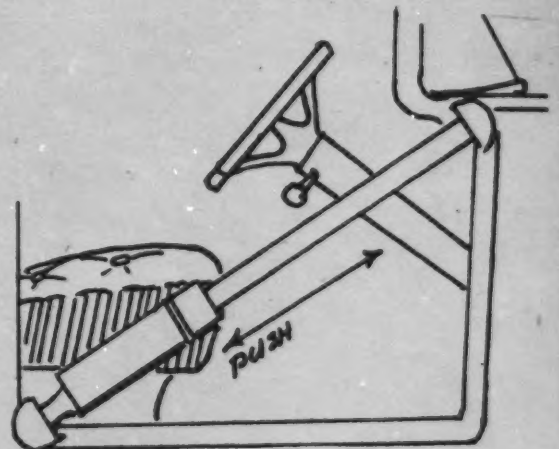
TENSION PLATES:

1. Close pump valve.
2. Take up slack in the set-up by using a steady pumping action on the pump handle.
3. Continue pumping operation to straighten damage, checking frequently to determine progress.

NOTE: Do not apply excessive force or panel may be torn out.

4. Open the pump valve to release pressure.
5. Loosen plates from the porto-power.
6. Disassemble equipment and place protective cap on ram threads.
7. Replace in proper storage facilities.

INTRODUCTION: Porto-powers are used for a variety of straightening operations. It must be remembered that porto-powers operate on hydraulic pressure, and very little force on the operator's part is necessary to exert a tremendous amount of force on the work. Be careful not to overwork the equipment or the job.



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COMPETENCY: Use Pull Rods

COURSE: Automotive Body and Fender

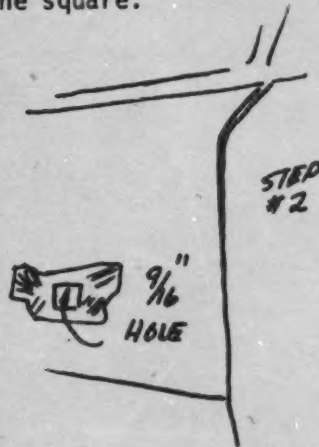
UNIT I: Metal Work

OBJECTIVE: The student will be able to use pull rods

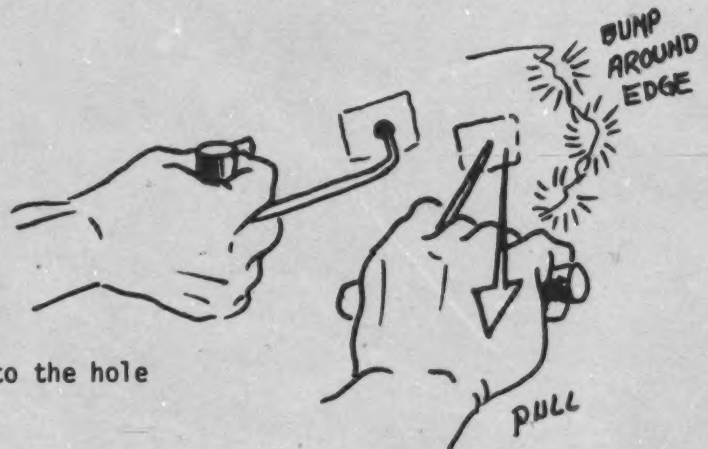
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Locate low section of the panel crease.
2. Pick a small (1" square) area near the edge of the low spot and center punch and drill a 9/64" hole in the center of the square.



INTRODUCTION: Pull rods are used to exert a steady outward pull on a low spot while working the perimeter with a body hammer. Pull rods can be used separately or, depending on the type of damage, with as many as four (two in each hand) at a time.



3. Insert the pull rod hook into the hole drilled in step 2.

4. Pull the pull rod outward from the panel and bump the perimeter with the body hammer.
5. Repeat steps 2 and 4 as needed to finish the operation.

NOTE: Take care not to break the pull rod.

OPERATION SHEET
SC-1E-1

COMPETENCY: Remove and Replace Defective Nuts and Bolts

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to remove and replace defective nuts and bolts

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Apply proper rust solvent.	NOTE: Allow time for solvent to penetrate. Several applications may be necessary.
2. Remove bolt with correct size wrench or socket.	INTRODUCTION: Cap screws which are rusted in place will often be difficult to remove or will twist off while trying to remove them. Nuts can also rust in place on a bolt, making it difficult or impossible to remove them with a wrench. Special techniques are needed in these cases.
3. Select appropriate screw extractor and drill, if bolt breaks.	
4. Center punch and drill hole in bolt for extractor.	
5. Insert extractor in tap wrench and insert into drilled holes.	
6. Turn tap wrench in counter-clockwise direction to remove bolt.	
7. Select appropriate size tap and tap drill, if bolt will not come out.	
8. Drill out bolt with tap drill.	
9. Tap new threads into the bolt hole by inserting tap into drilled hole and making a half turn to start it.	
10. Flood with cutting oil and make one full turn.	
11. Back off 1/2 a turn, then continue in same pattern of one full turn in and back off 1/2 turn until hold is tapped enough.	

COMPETENCY: Use the Hog Ring Pliers

COURSE: Automotive Body and Fender

UNIT I: Metal Work

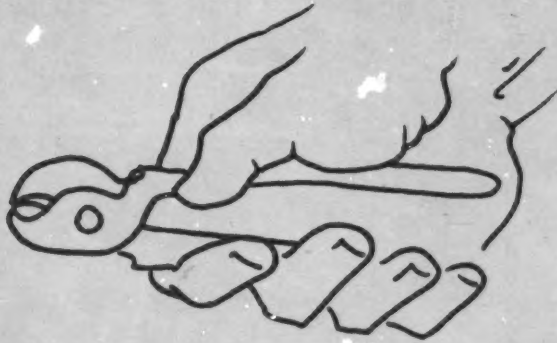
OBJECTIVE: The student will be able to upholster car seats using hog ring pliers

Page 1 of 1 page

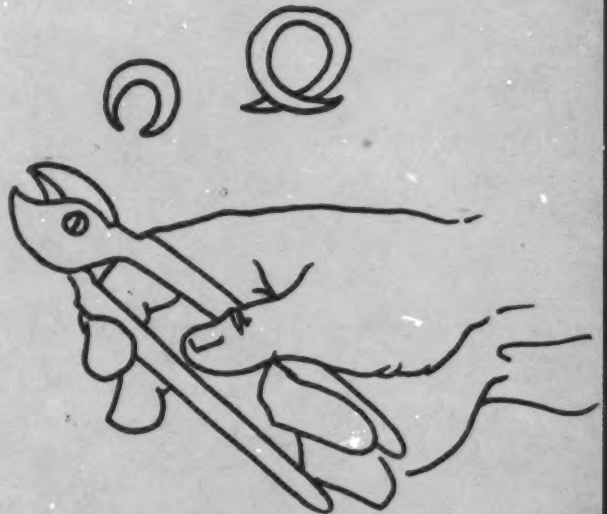
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Grasp pliers thumb over top handle, fingers under and around bottom handle.



2. Open pliers by resting pliers in palm of hand, securing one handle with three fingers against palm and extending opposite handle with forefinger and thumb.
3. Insert hog ring to jaws of pliers.
4. Position open pliers exactly where fabric is stretched.
5. Squeeze handles together to insert hog ring into position.



COMPETENCY: Replace Seat Springs

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to replace seat springs properly and safely

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

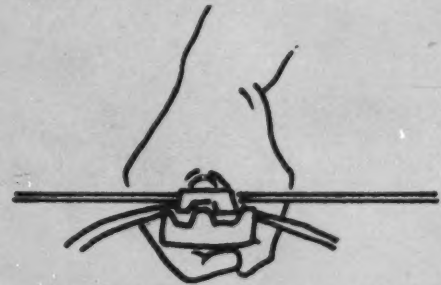
TEACHING/LEARNING ACTIVITIES

1. Position seat frame on trestles.

SPIRAL SPRINGS:

2. Measure seat opening to determine how many to use.
3. Set springs on base in straight lines, side to side, front to back.
4. Secure springs using klinch-it tool.

NOTE: Spring Clip Pliers can also be used..



5. Start with the first row proceeding front to back, klinching each spring at least four times.

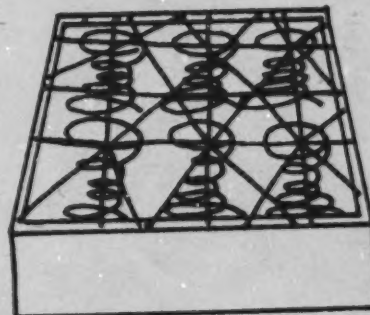
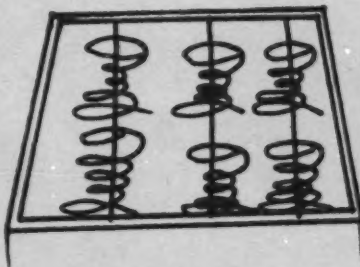
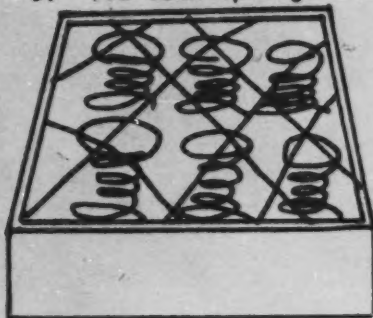


NOTE: Place notched end of tool over rim of spring, already positioned. Apply downward pressure on tool. Grasp handle of tool with right hand and squeeze in order to release clip into burlap, securing spring.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

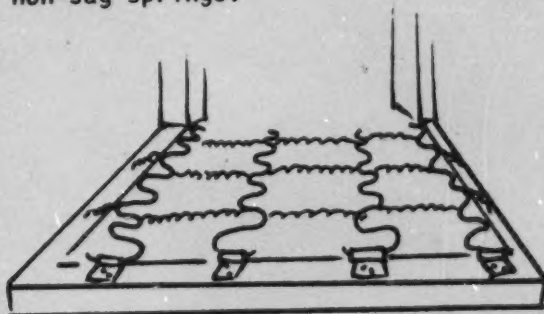
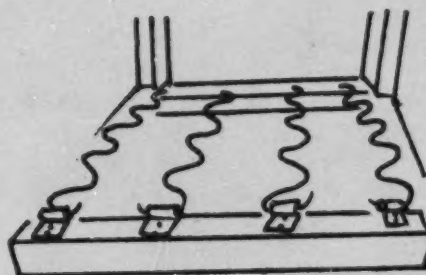
TEACHING/LEARNING ACTIVITIES

6. Tie down springs with twine.



NON-SAG SPRINGS:

2. Measure seat opening to determine the length of springs.
3. Cut springs to length.
4. Nail clips on front and back rails.
5. Hook the spring end into the clips alternating the direction of bend.
6. Nail down the upper part of the clip.
7. Place helical springs perpendicular to rows of non-sag springs.



COMPETENCY: Replace Bobbin

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to replace bobbin

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Open the right bed side.	INTRODUCTION: A bobbin is what holds the thread to be picked up by the needle as it goes through the bed side. If the bobbin is empty, there will be no stitch.
2. Turn the machine pulley towards oneself until the needle bar has reached its highest point.	
3. Lift up bobbin latch.	
4. Remove bobbin.	
5. Hold bobbin.	
6. Hold the bobbin between thumb and forefinger of the right hand.	NOTE: The thread must unwind at the bottom from left to right.
7. Put bobbin on to the center stud and close latch.	
8. Pull the thread into slot of the bobbin case.	NOTE: The bed slide should not be closed completely to allow the thread to be pulled down.
9. Draw thread underneath the back of projection on the bobbin case.	
10. Draw the thread through until it extends approximately two inches out of the bed slide opening.	
11. Clean up area.	

OPERATION SHEET

SC-1F-4

COMPETENCY: Wind the Bobbin

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to wind the bobbin

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	
1. Place the bobbin on to the bobbin winder spindle sliding it on the spindle until it stops. 2. Pass the thread through the thread guide in the tension control bracket and between the tension discs to the bobbin. 3. Thread a few windings on the bobbin. 4. Press down lever to push the bobbin winder pulley against the drive belt. 5. Start the sewing machine. 6. Engage belt in motion. 7. Remove the bobbin from the bobbin winder. 8. Release belt lever to bobbin winder. 9. Clean up area.	INTRODUCTION: Using the sewing machine it is necessary to learn to wind the bobbin. This is essential when learning to sew. NOTE: When enough thread has been wound on the bobbin, the winder will stop automatically.

OPERATION SHEET

SC-1F-5

COMPETENCY: Thread the Sewing Machine Needle and Adjust Stitch Length

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to thread sewing machine needle and adjust stitch length

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Turn the machine pulley so the needle is at its highest position.
2. Pass the thread from the unwinder through the hole in thread guide.
3. Pass thread through the three holes of the thread tensioner guide.
4. Starting with top hole, thread from right to left.
5. Thread from left to right through the middle hole.
6. Thread from right to left through bottom hole.
7. Pass the thread over and between the tension disc.
8. Thread from right to left and wind it under and around thread controller.
9. Thread from right to left and place under the controller spring.
10. Thread over the controller projection so that the controller spring holds the thread down.
11. Pull thread through the thread guide.
12. Pull thread from left to right through the eye of the thread take-up.
13. Pass thread back through the thread guide.
14. Lead the thread behind the oil felt pad.

INTRODUCTION: The proper method of preparing the sewing machine for use is as follows: Threading the machine needle, adjust tension control and adjustment of stitch length which regulates the strength of the seam.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

15. Draw thread through the thread guide.
16. Put thread from left to right through the eye of the needle.
17. Hold the end of the needle thread loose in the left hand.
18. Turn the machine pulley towards oneself until needle has made one full stitch and is back to its highest point.
19. Pull the needle thread and the bobbin thread through the hole in the feed dog.
20. Lay both threads underneath the presser foot and close the bed side completely.
21. Adjust the tension of the needle thread.
22. Adjust the tension of bobbin thread.
23. Loosen and adjust the stitch length by using the indicator on machine pulley and lock.
24. Clean up area.

NOTE: The stitch length can be adjusted only when the machine is stopped.

NOTE: Ready to sew.

COMPETENCY: Sew with Sewing Machine

COURSE: Automotive Body and Fender

UNIT I: Metal Work

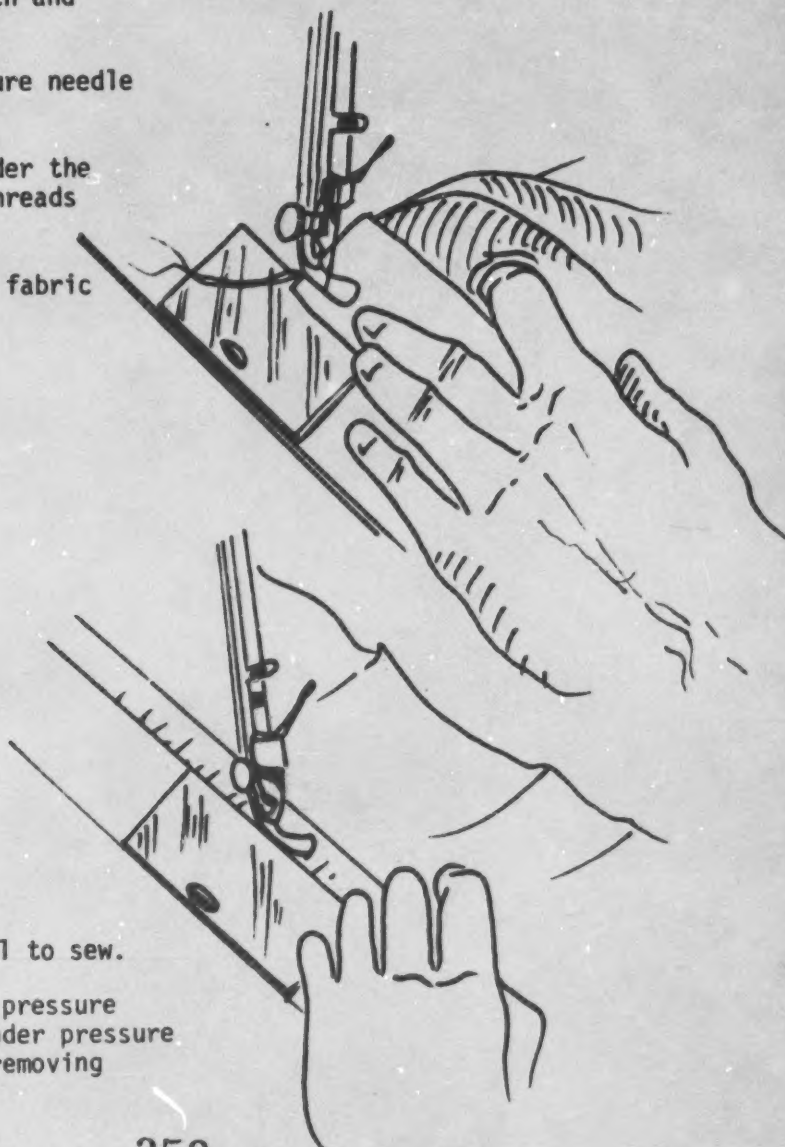
OBJECTIVE: The student will be able to neatly and accurately sew seat covers and other material

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Turn switch to the "on" position.
2. Select the proper size stitch and lock into place.
3. Lift pressure foot making sure needle is in the up position.
4. Place fabric to be sewn, under the pressure foot making sure threads are clear.
5. Lower pressure foot to keep fabric in place.



6. Apply pressure to foot pedal to sew.
7. Complete sewing by lifting pressure foot, removing work from under pressure foot, cutting threads and removing material.

OPERATION SHEET
SC-1G-1

COMPETENCY: Remove Reveal Molding

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to remove reveal molding for easy removal of glass

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

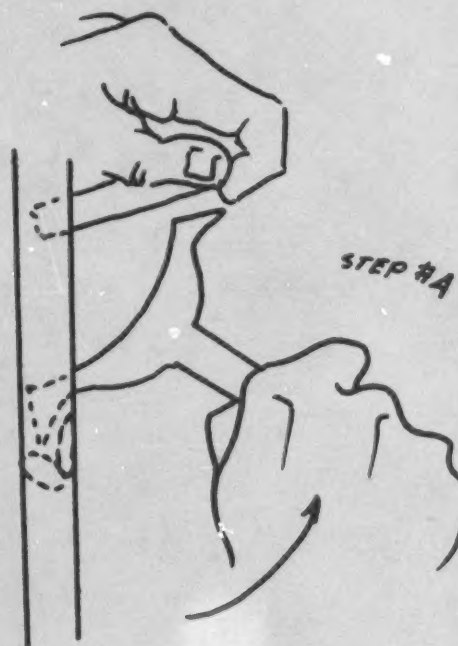
TEACHING/LEARNING ACTIVITIES

1. Insert stick between glass and molding and pry out molding to locate clip.



INTRODUCTION: It is necessary to remove the reveal moldings before the glass can be removed, since the molding is held to the body by clips.

2. Locate jaw flat to glass.
3. Locate clip and place tip of tool under clip.
4. Keeping the tool surface flat to the glass, "roll" the tool to unsnap the clip from the molding.



OPERATION SHEET
SC-1G-2

COMPETENCY: Remove Glass with Hot Knife

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to remove glass with a hot knife taking care not to crack or break glass

Page 1 of 1 page

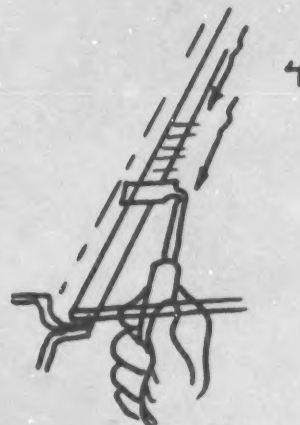
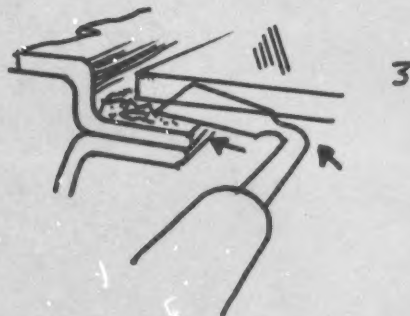
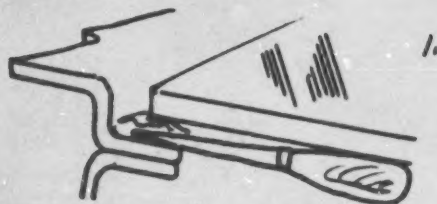
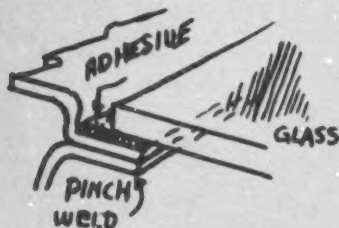
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Punch hole in adhesive between glass and pinch weld with sharp knife or awl.
2. Plug in hot knife.
3. Insert hot knife blade into hole in adhesive.
4. Pull knife along pinch weld keeping it parallel to glass and pinch weld.
5. Continue pulling knife until glass is cut free of adhesive.

INTRODUCTION: Butyl rubber mounted glass must be removed by a hot knife or piano wire to cut the glass free of the adhesive.

NOTE: Do not tilt knife or glass could be broken.

NOTE: If piano wire is used insert through hole, leave approximately 20" of wire on each side of glass and cut glass free with a sawing motion.



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OPERATION SHEET
SC-1G-3

COMPETENCY: Use Caulking Gun to Apply Adhesive

COURSE: Automotive Body and Fender

UNIT I: Metal Work

OBJECTIVE: The student will be able to use a caulking gun to apply rubber adhesive

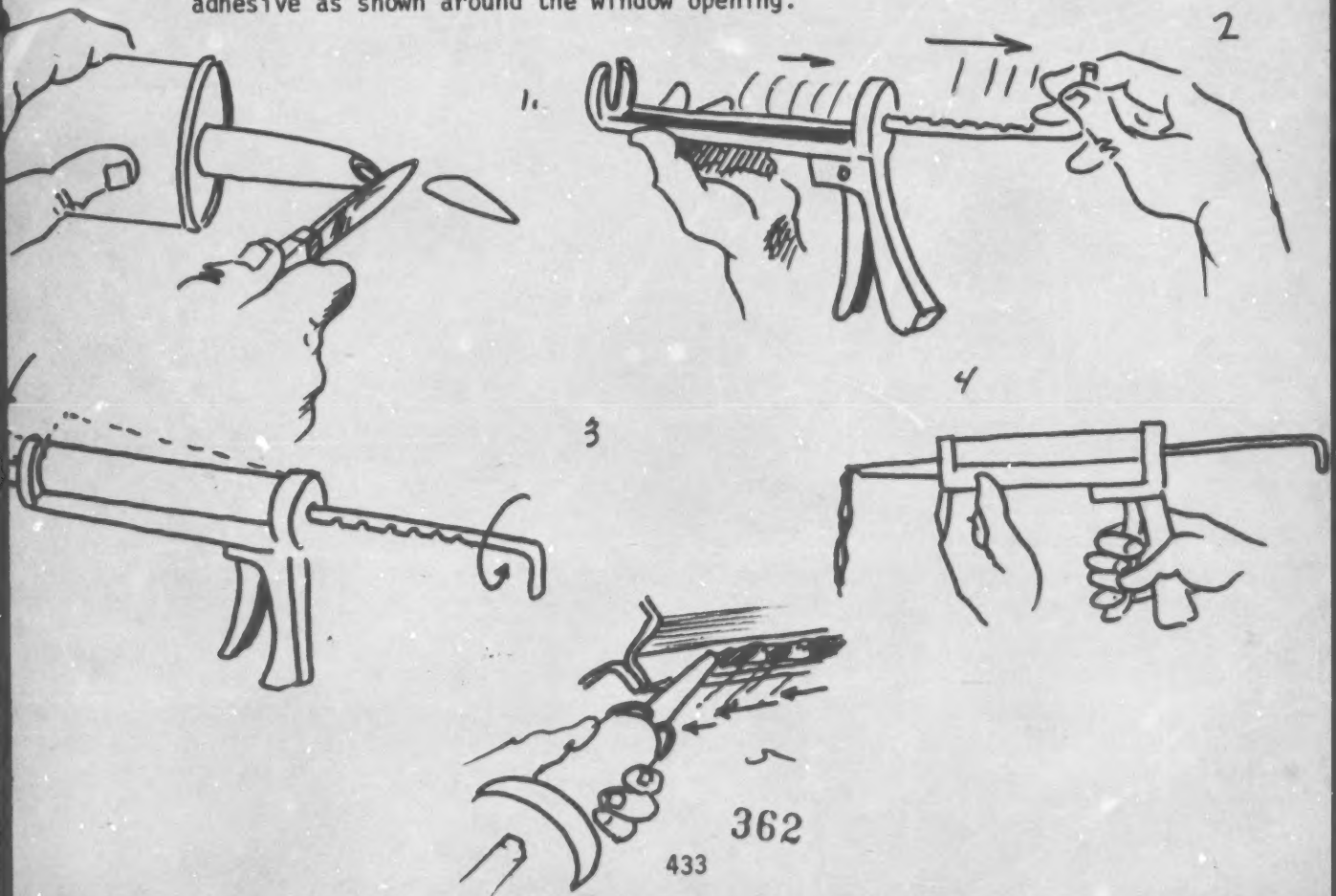
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Using a knife, clip off end of cartridge spout at a slight angle.
2. Reverse and pull back plunger handle.
3. Insert cartridge back end first into gun.
4. Release gun plunger handle so that the plunger ratchets forward when trigger is squeezed.
5. Place tip against pinch weld and apply adhesive as shown around the window opening.

INTRODUCTION: Butyl rubber adhesive can be acquired in cartridge or strip form.



OPERATION SHEET
SC-2-1

COMPETENCY: Clean a Surface Prior to Sanding

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to properly clean a surface prior to sanding

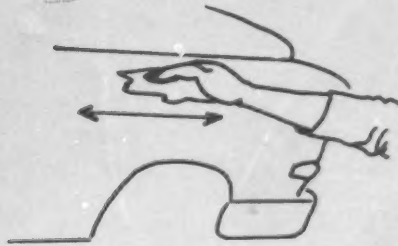
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Wash area to be sanded with water and detergent and rinse.
2. Dry off area with air gun.
3. Apply wax/grease/tar remover to a 2 ft. square area, with a wiper.

INTRODUCTION: A surface to be sanded should be free of dirt, wax, tar and grease to achieve proper cutting action with the abrasive paper. Certain waxes, tar and grease will clog the abrasive paper and reduce its effectiveness.



4. Dry with a clean, dry wiper.
5. Repeat until panel is clean.

OPERATION SHEET
SC-2-2

COMPETENCY: Feather Edge and Sand a Panel

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to feather edge and sand a panel in preparation for painting

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

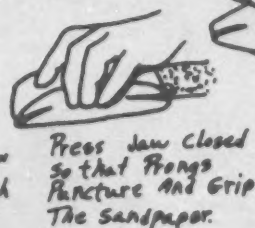
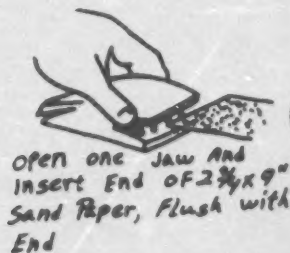
TEACHING/LEARNING ACTIVITIES

1. Fasten #80D production paper to sanding block.



INTRODUCTION: A rusted or bare metal area to be painted is lower than the surrounding color coat area. To avoid an outline of the bare metal area showing through on a finished color coat, the edge of the area must be "feather-edged" or made perfectly smooth so the new color coat will blend with the existing color coat.

2. Taper broken edge of color coat down to bare metal with sanding block.



3. Repeat #2 with #320 abrasive paper, extend 4"-6" into painted area; and sand until scratches from #80D production paper are gone.

NOTE: When sanding, lap over into color coat area about 3/4 of the length of the sanding block. If using a jitter-but, choose #80D production paper. If using a DA or circular sander choose #150-#180 abrasive paper.

COMPETENCE - PROCEDURE/STEPS

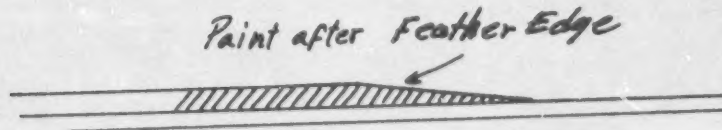
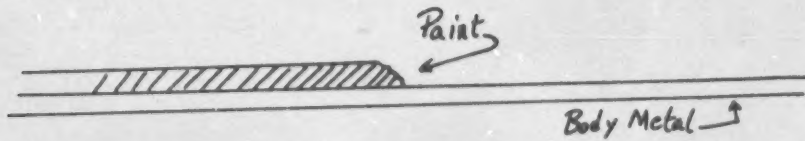
TEACHING/LEARNING ACTIVITIES

4. Sand entire panel with #360 abrasive paper using sanding block or squeegee.

NOTE: Check progress by intermittently squeegeeing the area and looking for dull spots.

5. Wash panel with water.

6. Blow dry with air gun.



OPERATION SHEET

SC-2-3

COMPETENCY: Apply Masking Tape

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to apply masking tape

Page 1 of 2 pages

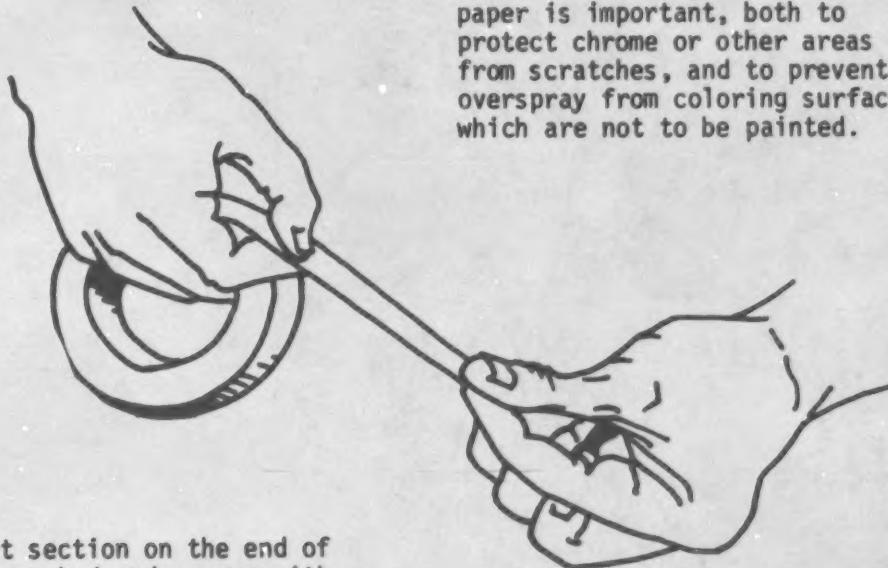
COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Clean area to be masked.
2. Pull a short piece of tape loose from the roll.

NOTE: Use air gun on moldings to blow off dirt, etc.

INTRODUCTION: Correct application of masking tape and/or paper is important, both to protect chrome or other areas from scratches, and to prevent overspray from coloring surfaces which are not to be painted.



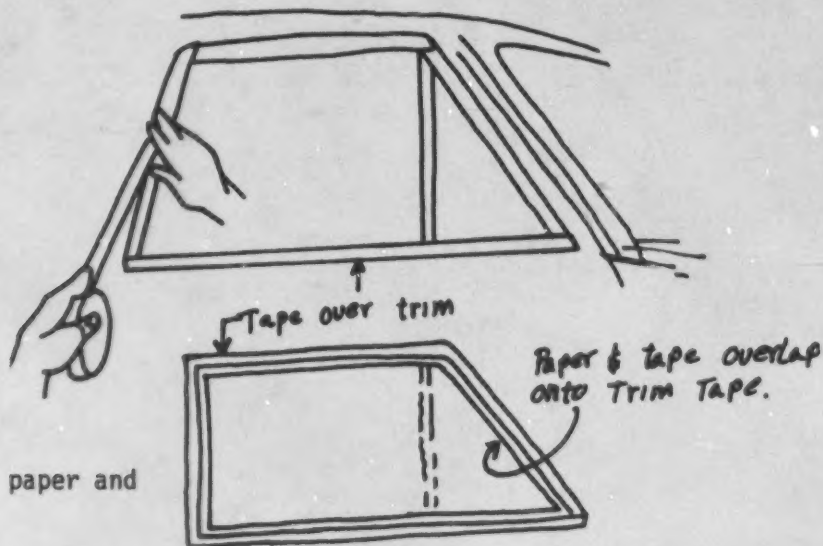
3. Place the short section on the end of the part to be masked and secure with one hand, holding the roll in the other hand.

COMPETENCE - PROCEDURE/STEPS

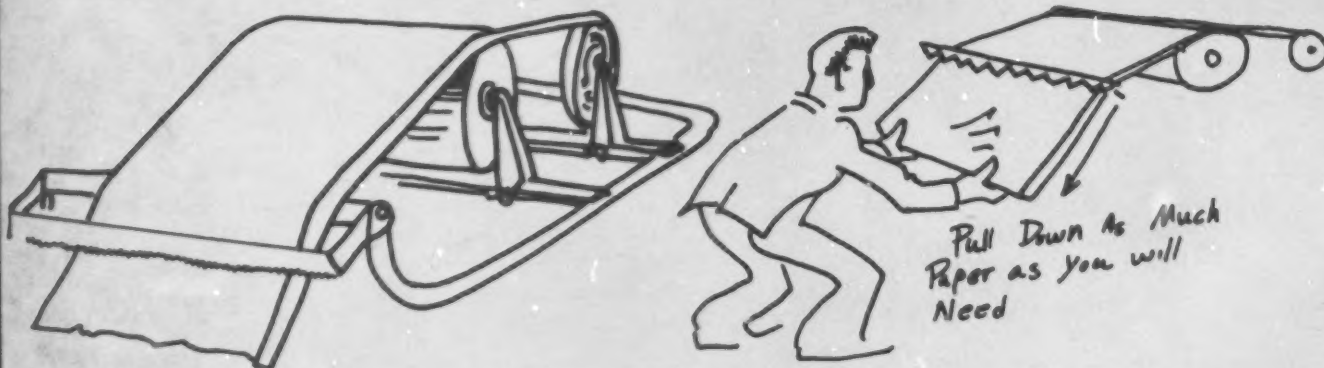
TEACHING/LEARNING ACTIVITIES

4. Guide the tape being applied with the hand holding the roll and secure the tape with the other hand by sliding it along over the tape.

NOTE: Make sure the tape edge is firmly fastened to the surface.



5. Remove correct length of paper and tape from machine.



6. Apply paper the same way tape is applied.

NOTE: Check to see that about 1/3 of the tape is on paper, leaving 2/3 free to adhere to job.



OPERATION SHEET
SC-2-4

COMPETENCY: Deoxidize Sheet Metal

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to deoxidize sheet metal

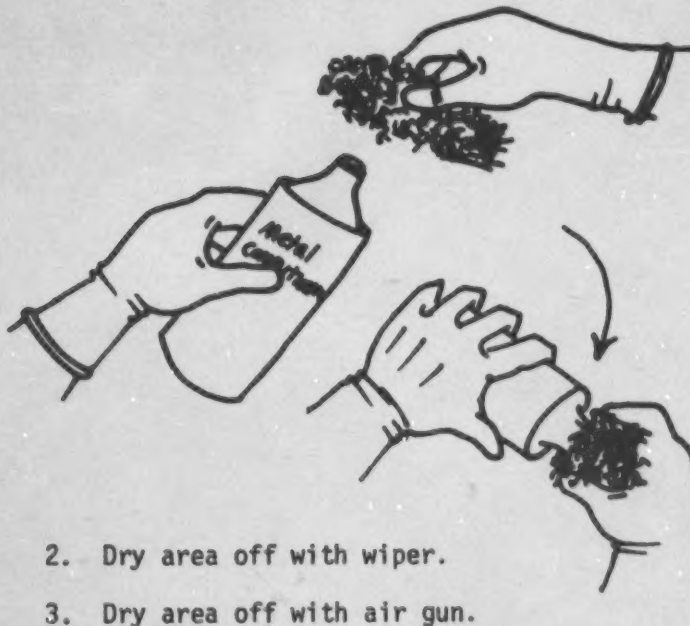
Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Mix and apply metal conditioner to area with a saturated steel wool pad.



2. Dry area off with wiper.
3. Dry area off with air gun.

INTRODUCTION: Metal, especially in moist or damp areas, will combine rapidly with oxygen in the air to form iron oxide or, as it is commonly called, rust. Even where rust is not visible on metal, there is always some oxidation, which will prevent primer from forming a tight solid bond with the metal. This oxide must be removed prior to priming.

CAUTION: Wear rubber gloves for this operation.

NOTE: Do not let metal conditioner set on painted surfaces.



OPERATION SHEET
SC-2-5

COMPETENCY: Mix Primer-Surfacer

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to mix primer-surfacer

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Agitate primer in its own container by stirring. 2. Fill 1/3 of the spray gun cup with primer. 3. Stir correct amount of appropriate lacquer thinner into primer as per manufacturer's instructions.	INTRODUCTION: A color coat will not adhere to bare metal surface very long without an undercoating of primer-surfacer. The primer-surfacer acts as a bonding agent for the color coat, builds up bare metal areas, and acts to fill scratches left by abrasive paper to make a perfectly smooth surface for a color coat.

COMPETENCY: Adjust and Use Spray Gun

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to adjust and use a spray gun

Page 1 of 3 pages

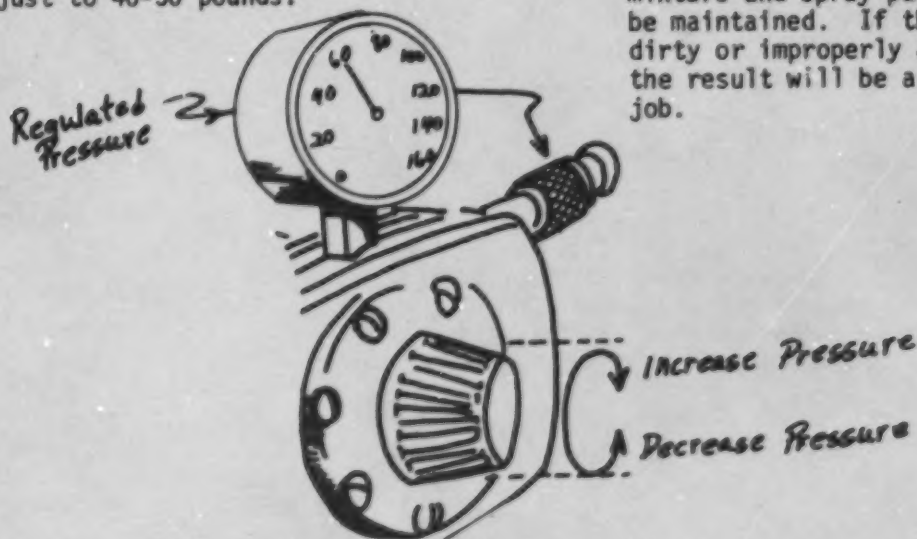
COMPETENCE - PROCEDURE/STEPS

The student will be able to:

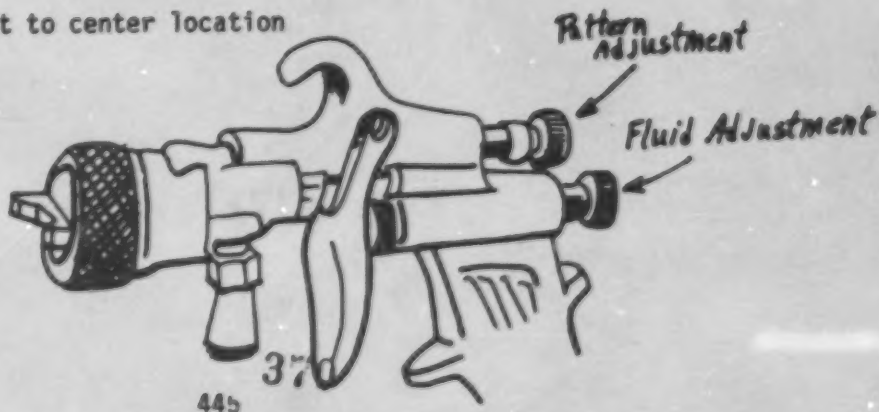
TEACHING/LEARNING ACTIVITIES

1. Attach cup of thinned primer-surfacer to spray gun. (See SC-2-5)
2. Attach air hose to spray gun by pushing the coupling on to gun.
3. Check working pressure regulator and adjust to 40-50 pounds.

INTRODUCTION: The spray gun is one of the most important and sensitive tools in the shop. It must be kept absolutely clean and in proper adjustment. Spray gun adjustments are critical if a proper air-fluid mixture and spray pattern is to be maintained. If the gun is dirty or improperly adjusted, the result will be a poor paint job.



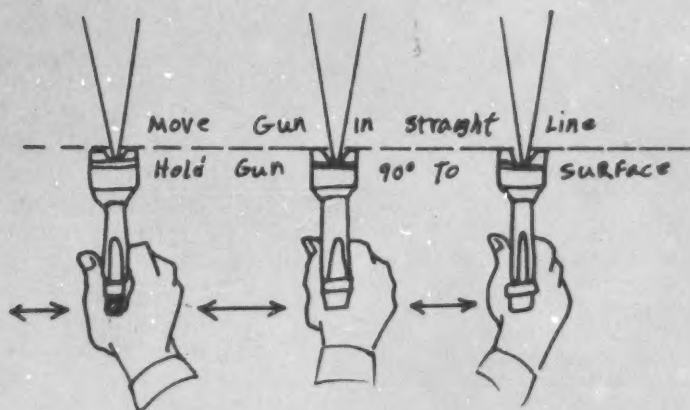
4. Squeeze spray gun trigger and readjust regulator.
5. Set air adjustment to center location (half way).



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Set pattern adjustment to center location (half way).



7. Holding the spray gun 8"-10" from the surface, test spray on panel or test surface, and adjust both air and fluid for job requirements and weather conditions to get uniform pattern and proper degree of wetness.
8. Hold gun level and at right angles to surface.
9. Start at the top of the surface to be painted and with the center of the nozzle even with the top edge of the surface, move the gun from right to left with a steady, deliberate motion of about 1 ft. per second, keeping gun parallel to the surface.

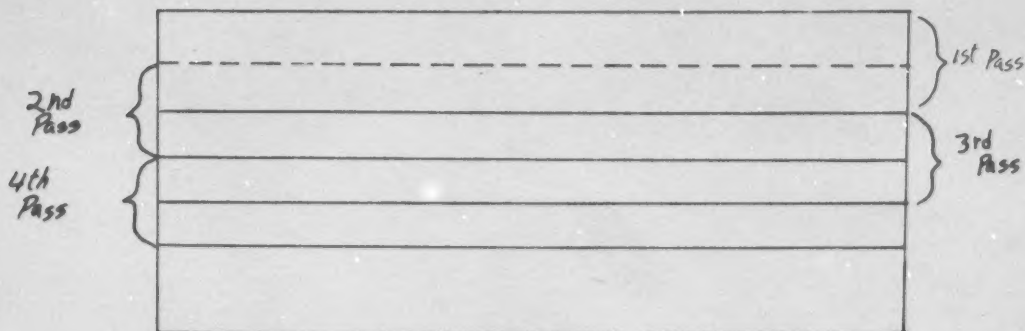
NOTE: On flat surfaces such as a hood or roof, gun should point straight down.

NOTE: Do not move the spray gun in a ARC, except when spot-painting.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

10. Release the trigger at the end of each pass, then pull trigger upon beginning the next pass in the opposite direction.
11. Overlap each pass after the first pass one-half the height of the spray pattern.



12. Continue back and forth passes, triggering the gun at the end of each pass until the operation is completed.

NOTE: The last pass should be done with one-half of the spray pattern below the painted surface.

13. Clean the spray gun.

OPERATION SHEET
SC-2-7

COMPETENCY: Mix and Strain a Color Coat Paint

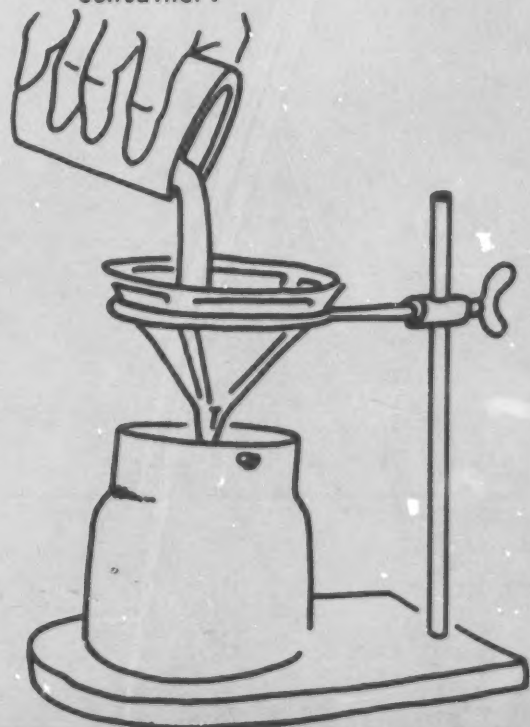
COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to mix and strain a color coat paint

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Remove container lid and agitate paint by stirring. 2. Pour paint into clean proper size mixing container. 3. Fill original paint container with appropriate amount of thinner or reducer. 4. Replace lid tightly and shake container thoroughly. 5. Remove lid, stir and pour thinner into mixing container. 6. Measure out and add necessary additional thinner or reducer as per manufacturer's instructions on original paint container. 7. Pour added thinner or reducer into mixing container and agitate by stirring. 8. Strain paint-thinner mixture into spray gun cup until cup is 3/4 full.	INTRODUCTION: The bodyman's work is judged by the final color coat applied to the required area of a panel or car. Color coats must be thoroughly mixed to prevent separation of pigment. They must be well-strained and absolutely clean of any foreign matter to have an acceptable finished appearance. NOTE: Make sure all pigment is removed from original container.



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OPERATION SHEET
SC-2-8

COMPETENCY: Spray Lacquer

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to spray lacquer

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
<u>SPOT REPAIR</u> 1. Adjust air pressure to proper working pressure. 2. Adjust spray pattern to suit the job. 3. Hold gun 5"-8" from the surface as previously described. 4. Spray one single medium coat and allow to flash (grow dull). 5. Spray 3 to 4 wet coats, extending each one slightly beyond the previous one and allowing each coat to flash before applying the next coat. 6. Blend new finish with old finish with one mist coat.	NOTE: Refer to SC-2-6 before beginning this operation. INTRODUCTION: Application of the color coat is important to the appearance of the finished job. All color coats are NOT applied the same way. Therefore, follow exactly these instructions for apply lacquer.
<u>PANEL OR CAR REPAINTING</u> 1. Adjust air pressure to proper working pressure. 2. Adjust spray pattern. 3. Hold spray gun 6"-8" from the surface. 4. Spray 3 to 4 wet double coats, allowing each coat to flash before applying the next coat.	CAUTION: A respirator must be worn for this operation!

OPERATION SHEET

SC-2-9

COMPETENCY: Clean a Spray Gun

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to clean a spray gun

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

1. Loosen spray cup and lift suction tube above paint level in cup.
2. Unscrew the air nozzle about three turns.
3. Hold a rag over the air cap and pull the trigger for a few seconds.

INTRODUCTION: A clean spray gun is essential to proper spray gun operation. A spray gun which has not been cleaned properly will tend to clog and "sputter", giving an uneven or improper spray pattern, and a poor air-fluid mixture. Any of these conditions will result in an unsatisfactory finished job.



4. Remove leftover paint from the cup and fill with about one inch of solvent.
5. Place the cup back on the gun, tighten the air nozzle, and pull the trigger to clean paint from the internal passages in the gun.
6. Remove the nozzle, soak it in solvent, and dry it with compressed air.
7. Replace the cap on the gun, wipe the entire gun off with a solvent-soaked rag and thoroughly clean the paint cup.

NOTE: If holes have become clogged, soak air cap in lacquer thinner and blow clean with air gun. DO NOT USE WIRE OR SMALL NAILS--HOLES COULD BE RUINED.

OPERATION SHEET

SC-2-10

COMPETENCY: Spray Enamels

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to spray enamels

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS

The student will be able to:

TEACHING/LEARNING ACTIVITIES

1. Adjust air pressure to 50-60 pounds working pressure.
2. Adjust gun for a full spray pattern.
3. Hold gun 8"-10" from the surface.
4. Spray one medium coat and allow it to become tacky.
5. Spray a full second coat over the first coat when tacky.

NOTE: Refer to SC-2-6 before beginning this operation; refer to SC-2-7 for proper mixture.

INTRODUCTION: As with lacquer, application of enamel is different than other finishes and special techniques must be used.

NOTE: Check for tackiness by touching a masked area. If paint is sticky, but non adheres to fingers, the surface is ready for the second coat.

OPERATION SHEET

SC-2-11

COMPETENCY: Degrease an Engine

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to properly degrease on engine

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Park the car in the appropriate spot, either inside or outside.	NOTE: Battery must be disconnected prior to spraying.
2. Mix detergent solution in a bucket using manufacturer's instructions.	INTRODUCTION: Part of the job of reconditioning a car is cleaning the engine. A clean engine makes a very favorable impression on the customer, since it means that somebody cared enough about the appearance of the car to take the time to clean it up properly.
3. Connect air hose and gunk gun to air supply. Set regulator for 50 pounds working pressure.	Engine cleaning can be a dirty job, so the car should be parked either outside or inside over a floor drain to allow the water and dissolved grease and dirt to flow away. If a steam cleaner is used, the car must be parked outside the building.
4. Spray engine and engine compartment thoroughly with the detergent solution getting into all the cracks and corners and allow to stand five minutes.	NOTE: If you must start the engine immediately to move the car, allow the engine to run long enough to completely warm up and dry thoroughly.
5. Scrape grease which did not come loose. Putty knife and use a brush to loosen it.	
6. Spray engine again, thoroughly and repeat step #4 until engine and engine compartment is clean.	
7. After engine is rinsed, take the air gun and blow excess water off the ignition system and battery.	

OPERATION SHEET
SC-2-12

COMPETENCY: Clean Upholstery with a Brush

COURSE: — Automotive Body and Fender

UNIT II: Spray Painting

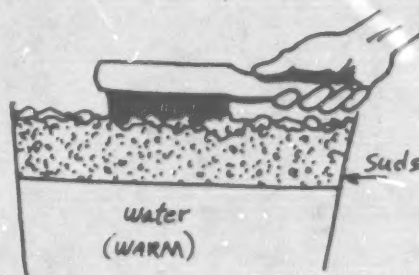
OBJECTIVE: The student will be able to clean upholstery

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Mix cleaning solution in warm water.
2. Dip brush into suds only as shown.
3. Using a circular motion, clean the upholstery.
4. Sponge upholstery to remove suds.
5. Repeat steps 2, 3, and 4 until upholstery is properly cleaned.
6. Dry upholstery.

INTRODUCTION: A car which is clean on the outside will still not appear clean if the upholstery is dirty. Upholstery cleaning is a relatively simple job, but again one which must be done properly to look well.



OPERATION SHEET
SC-2-13

COMPETENCY: Stripe Body as Required by Hand

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to stripe body as required by hand

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Clean surface prior to sanding. 3. Apply masking tape. 4. Mix and strain color coat. 5. Apply striping paint by hand to the area desired using a sword point camel hair brush, or use a hand striping tool with an application wheel of the correct width for free hand striping. 6. Allow sufficient time to dry, compound and clean up area.	INTRODUCTION: There are two methods used to repair or replace painted pin stripes; the free hand method and the masking tape method. The free hand is the simplest procedure but the one requiring the highest degree of skill.

OPERATION SHEET
SC-2-14

COMPETENCY: Apply Strip Decal Transfers

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to apply strip decal transfers

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Clean surface prior to sanding. 3. Apply masking tape. 4. Position and align then transfer to the panel. 5. Fold the transfer back halfway and peel it off the release paper. 6. Press transfer down evenly with light finger pressure. 7. Properly position and firmly press it onto the panel surface using a plastic squeegee. 8. Lightly wipe the adhesive-sided ends of the stripes with alcohol and wrap them around the fender, door or quarter panel flange as required. 9. Remove the carrier paper from the stripe. 10. Clean up area.	INTRODUCTION: Strip decals are used on automotiles as an accessory for dressing up the car. This is a method of putting a strip or stripes to a surface in decal transfer form.

OPERATION SHEET
SC-2-15

COMPETENCY: Stripe Body Using Special Tape for Masking as Required
for Spray Striping

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

OBJECTIVE: The student will be able to stripe body as required by spray

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Clean surface prior to sanding. 3. Apply masking tape and paper. 4. Mix and strain color coat. 5. Adjust spray gun. 6. Apply lacquer finish 7. Clean spray gun. 8. Remove masking after sufficient drying time. 9. Clean up area.	INTRODUCTION: This procedure requires the aligning of two pieces of masking tape parallel with a space between them representing the desired stripe width.

OPERATION SHEET
SC-3-1

COMPETENCY: Activate Dry Charge Battery

COURSE: Automotive Body and Fender

UNIT III: Electricity

OBJECTIVE: The student will be able to activate dry charge battery

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Remove cell caps. 3. Add sufficient acid to each cell until separates are covered. 4. Hook battery up to a charger until battery receives full charge. 5. Clean up area.	INTRODUCTION: Dry-charged batteries (batteries in which the plates are charged but which contain no electrolyte) must be stored in a cool, dry area with as even a temperature as possible. Although the dry-charged battery will retain its charge over a long period of time, it is wise to activate the battery by the end of the third year of storage.

OPERATION SHEET
SC-3-2

COMPETENCY: Remove and Install a New Battery

COURSE: Automotive Body and Fender

UNIT III: Electricity

OBJECTIVE: The student will be able to remove and install a new battery

Page 1 of 1 page

COMPETENCE- PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Cover fender with protective cover. 3. Loosen battery terminals at battery. 4. Install battery cable puller and remove cables. 5. Remove the hold down plate. 6. Remove battery with battery carrier strap. 7. Remove corrosion from battery terminals and carrier with baking soda and water. 8. Place battery in holder so that posts are positioned properly. 9. Replace hold down securely. 10. Replace battery terminals to proper posts. 11. Clean up area.	INTRODUCTION: Dry-charged batteries (batteries in which the plates are charged but which contain no electrolyte) must be stored in a cool, dry area with as even as temperature as possible. Although the dry-charged battery will retain its charge over a long period of time, it is wise to activate the battery by the end of the third year of storage.

OPERATION SHEET
SC-3-3

COMPETENCY: Remove and Replace a Generator

COURSE: Automotive Body and Fender

UNIT III: Electricity

OBJECTIVE: The student will be able to remove and replace a generator

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Disconnect battery cables. 3. Remove wires from the generator. 4. Loosen generator and remove fan belt. 5. Remove generator. 6. Remove pulley nut. 7. Apply pulley puller to pulley and remove pulley. 8. Install pulley onto new generator. 9. Install pulley nut and tighten. 10. Install generator. 11. Install fan belt and tighten generator. (Check tension) 12. Install all wires. 13. Connect battery cables. 14. Polarize generator according to specifications chart. 15. Clean up area.	INTRODUCTION: The generator is an electromagnetic device driven by the engine. It is used to produce electricity to meet the needs of the electrical system. It also keeps the battery charged.

COMPETENCY: Remove and Replace an Alternator

COURSE: Automotive Body and Fender

UNIT III: Electricity

OBJECTIVE: The student will be able to remove and replace an alternator

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Disconnect battery positive cable to avoid an injury from the hot battery lead at alternator. 3. Remove two leads at alternator. 4. Loosen adjusting bolts and remove drive belt. 5. Remove alternator retaining bolts and take off alternator. 6. Remove pulley nut. 7. Apply pulley puller to pulley and remove pulley. 8. Install pulley onto new alternator. 9. Install pulley nut and tighten. 10. Install alternator and insert retaining bolts. 11. Install drive belt, check tensions and tighten adjusting bolts. 12. Replace two leads to alternator. 13. Connect battery cable. 14. Polarize alternator according to specifications chart. 15. Clean up area.	INTRODUCTION: Alternators are composed of the same functional parts as the Conventional D. C. generator but they operate differently: The field is called a rotor and is the turning portion of the unit. A generating part, called a stator, is the stationary member, comparable to the armature in a D.C. system. It regulates the output of the alternator-rectifier system.

COMPETENCY: Check for Sidesway, Sag and Mash

COURSE: Automotive Body and Fender

UNIT IV: Frame Work

OBJECTIVE: The student will be able to check for sidesway, sag and mash

Page 1 of 3 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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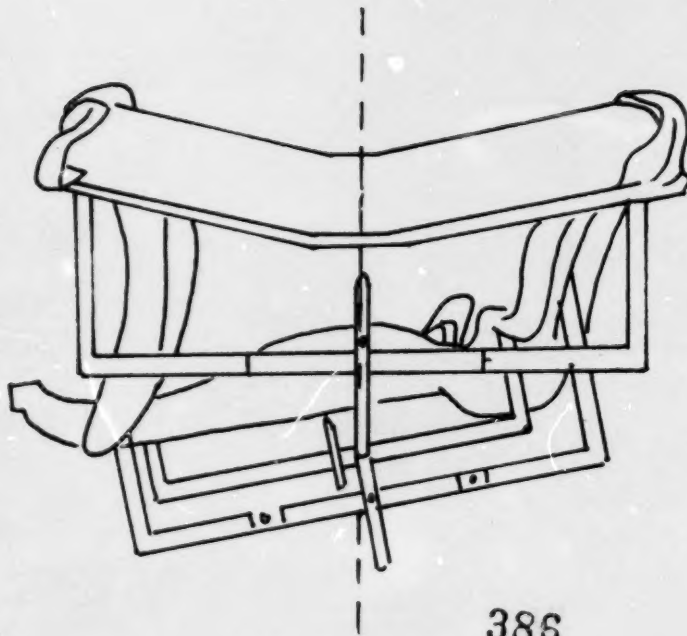
SIDESWAY

1. Analyze the job.
2. Place self centering gage ahead of the front cross member.
3. Place second gage at cowl area.
4. Place third gage at rear door area.
5. Sight the pointers on the gage from the front of the vehicle.

INTRODUCTION: Almost the only service required on frames results from accidents in which the frame has been twisted or broken. It is possible to repair such damage, if it is not too severe, by straightening the bent members and replacing or welding those that have been broken. In order to determine whether or not the frame has been bent, frame alignment can be checked by any of several methods.

NOTE: If pointers are not in line, the frame has sidesway.

NOTE: If rear end collision, remove front gage and install on rear cross member. Sight from rear of vehicle.



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COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

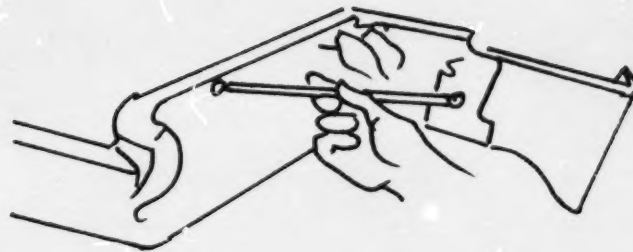
MASH

1. Analyze the job.
2. Make visual check of siderail just behind front cross member.
3. Check amount of damage by using measuring rods or tracking gauge.

NOTE: If a mashed condition exists buckles will be found on the under side of the siderail.

NOTE: You can determine the amount the siderail has been mashed by placing one end of the rod or gage at a rivet or hole on the outside at the cross member and the other end at a similar point on the siderail near the cowl. Then position the rod in same position on the opposite siderail.

NOTE: Use same procedure in rear end collision.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

SAG

1. Analyze job.
2. Place self centering gage ahead of the front cross member.
3. Place second gauge at cowl area.
4. Place third gauge at rear door area.
5. Sight the cross bars of the gages from the front of the vehicle.

NOTE: If first and second cross bars are not parallel with each other, a sag condition is present at the cowl area.

NOTE: If rear end collision, remove front gage and install on rear cross member. Sight from rear of vehicle.

COMPETENCY: Check for Tracking

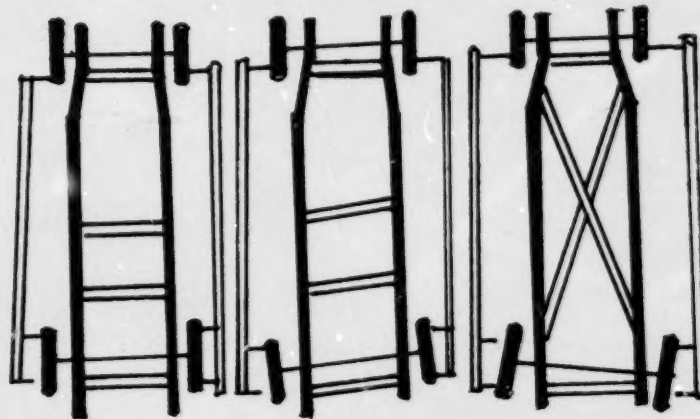
COURSE: Automotive Body and Fender

UNIT IV: Frame Work

OBJECTIVE: The student will be able to check for tracking

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
1. Analyze the job. 2. Place car in level position. 3. Remove wheel covers, if needed. 4. Center the toe. 5. Set up tracking gage from front wheel to rear wheel and take measurements on both sides of the car.	INTRODUCTION: Object of the tracking check is to determine whether car is shorter on one side or other.



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
6. Check the measurements on frame specification chart. 7. Replace wheel covers. 8. Clean up the area.	NOTE: If measurements are not accurate, check the following: front suspension, damaged frame or damaged differential.

COMPETENCY: Calibrate Front End Alignment Equipment

COURSE: Automotive Body and Fender

UNIT IV: Frame Work

OBJECTIVE: The student will be able to calibrate front end alignment equipment

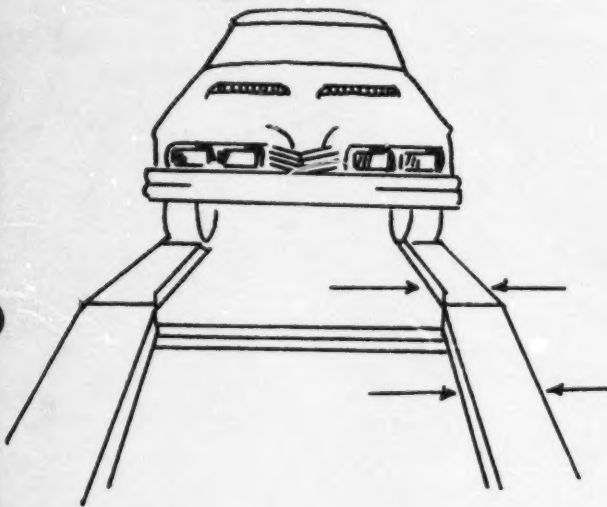
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COMPETENCE - PROCEDURE/STEPS
The student will be able to:

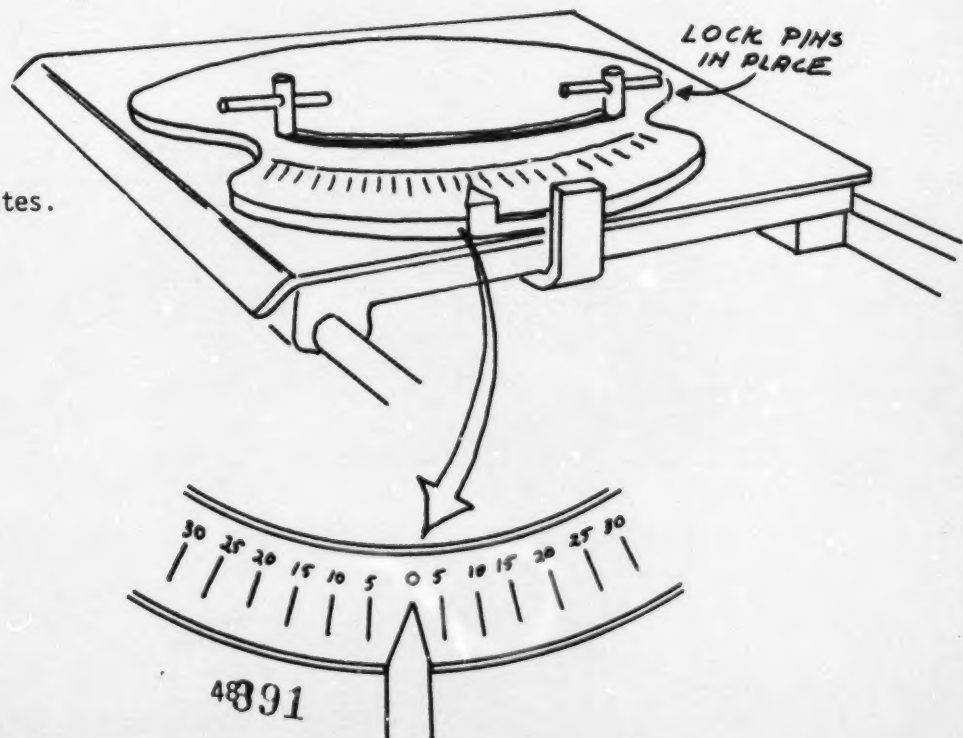
TEACHING/LEARNING ACTIVITIES

1. Prepare visualiner charts or specifications.
2. Adjust alignment rack.

INTRODUCTION: Preparation of equipment to align front end of car such as adjustments to rack, proper template for wheel alignment tester and manufacturer specifications for type of vehicle being aligned.



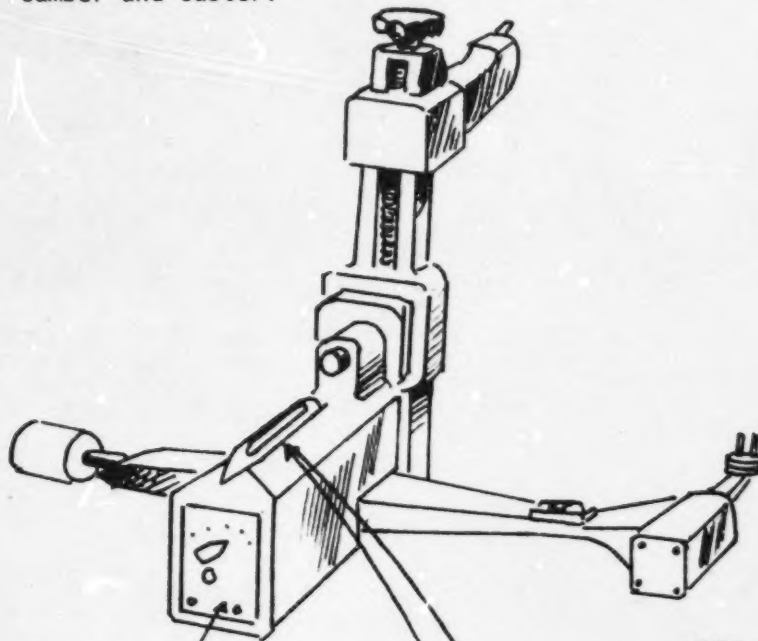
3. Lock radius plates.



COMPETENCE - PROCEDURE/STEPS

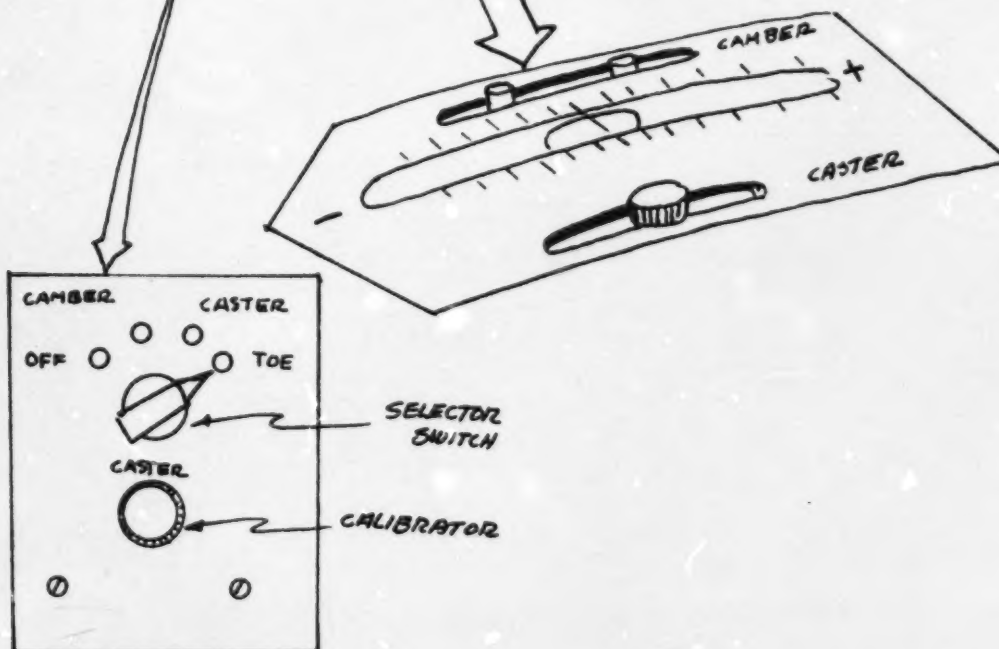
TEACHING/LEARNING ACTIVITIES

4. Adjust wheel alignment tester to check camber and caster.



5. Place car on rack.

NOTE: Have someone assist or direct the driver when placing the car on the rack.



COMPETENCY: Adjust Caster (Wheel Alignment)

COURSE: Automotive Body and Fender

UNIT IV: Frame Work

OBJECTIVE: The student will be able to adjust caster

Page 1 of 4 pages

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
The student will be able to:	

INTRODUCTION: Caster may be defined as the angle, when viewed from the side of the car, between the vertical and the steering axis of the kingpin or ball joints. Positive caster is the angle, measured in degrees, of the kingpin leaning rearward. Negative caster, of course, is the opposite or the angle of the kingpin leaning forward. Positive caster develops a certain amount of "lead" from the point where the line from kingpin axis intersects the road surface and from the point at which the wheel makes contact with road surface. This permits the wheel to be pulled instead of pushed.

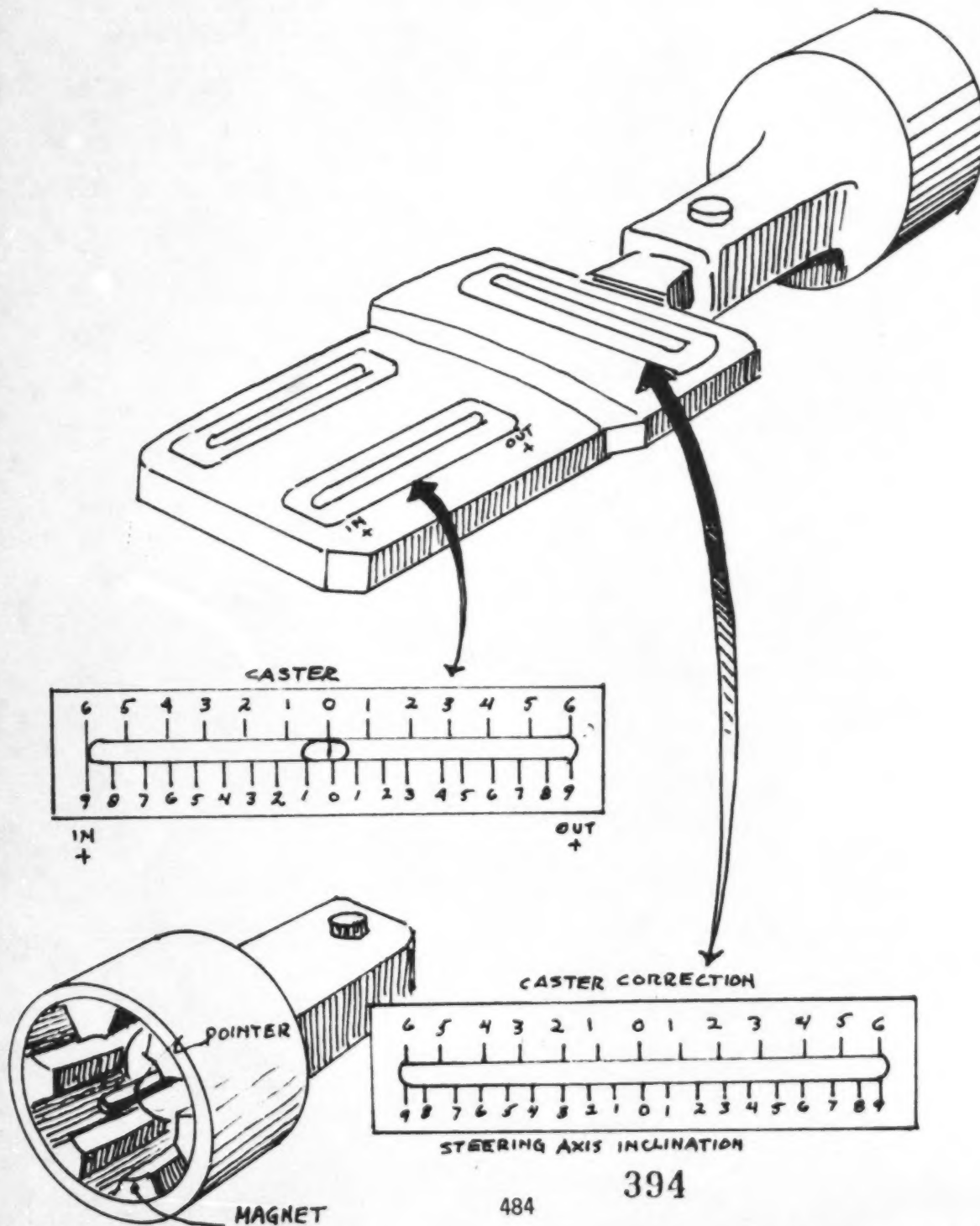
1. Proceed from camber adjustment.
2. Set the turning radius gauge to zero.

NOTE: Check for loose or worn parts before proceeding with caster alignment.

NOTE: With wheel alignment tester in place and wheels straight ahead.

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

TEACHING/LEARNING ACTIVITIES



COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
3. Turn the wheel in (front of wheel moving in) until the turning radius gage reads 20°.	
4. Adjust the caster level to be level (bubbles) squarely between the two cross lines at zero on caster scale.	NOTE: If the bubble on the caster level is not properly located then a correction adjustment is needed.
5. Turn wheel back in the opposite direction, stopping it when the turning radius gage reads 20°.	NOTE: This would be a 40° total swing.
6. Adjust if needed according to manufacturer's specifications.	
7. Change the caster by adding shims at one of the upper-control arm attachment-bolts and removing shims from the other.	

COMPETENCE - PROCEDURE/STEPS

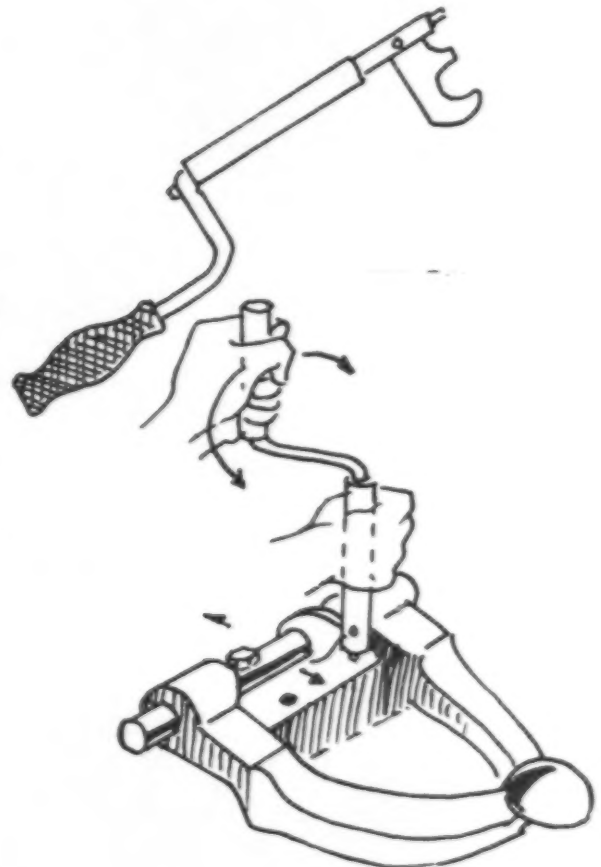
TEACHING/LEARNING ACTIVITIES

8. Change the caster by adjustment by shifting inner shaft because of elongated holes in frame.

9. Get a positive sign on gage by removing shim from front inner shaft mounting bolt or support bracket and add to rear bolt. (Reverse if negative is needed.)

10. Adjust caster by lengthening the street rods by turning the two nuts at the rear of the street rod to give you a positive reading. (Reverse if negative is needed.)

11. Complete and secure all adjustments.
12. Recheck final caster camber settings after retightening.
13. Remove brake pedal depresser.
14. Continue on to toe in alignment.



NOTE: Adjust caster by cams on some cars with a special tool. Changing one end--moving it in or out will give you either negative or positive.

COMPETENCY: Adjust Camber (Wheel Alignment)

COURSE: Automotive Body and Fender

UNIT IV: Frame Work

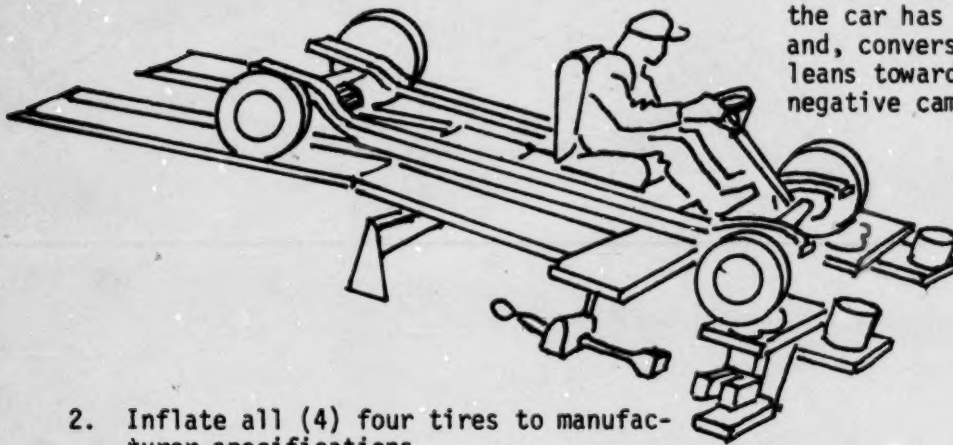
OBJECTIVE: The student will be able to adjust camber

Page 1 of 3 pages

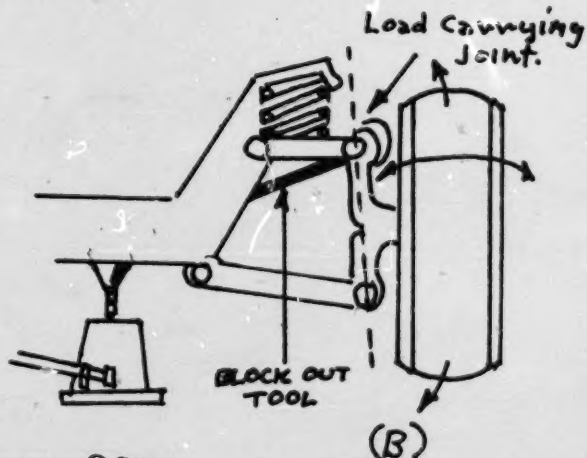
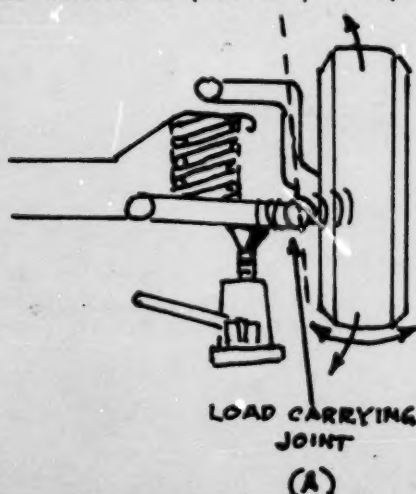
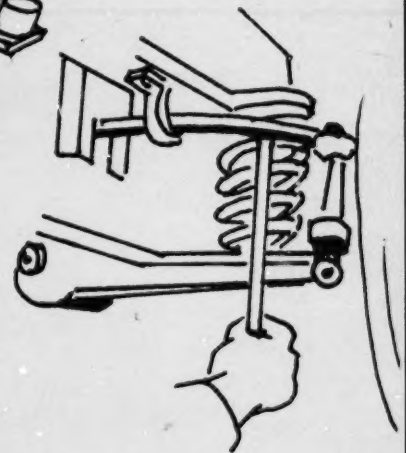
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Drive vehicle on to rack with wheels on turntables, (radius plates) and block one rear wheel.

INTRODUCTION: Camber is the amount, measured in degrees, that the wheel is inclined from a vertical position, viewing the car from the front. A wheel that leans away from the car has positive camber and, conversely, if the wheel leans toward the car, it has negative camber.



2. Inflate all (4) four tires to manufacturer specifications.
3. Adjust the vehicle to the manufacturer specified curb height.
4. Raise hood and install fender covers.
5. Lift left and right front wheels under control arms until the wheel just clears the turntable (radius plates).

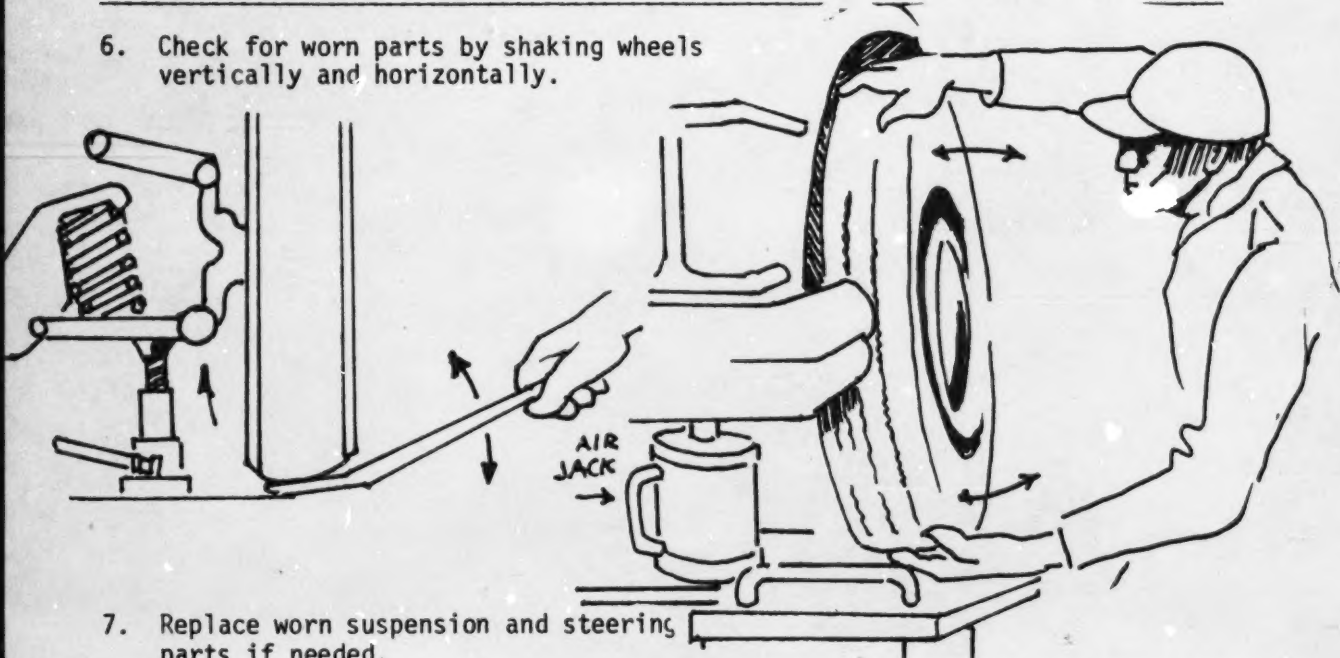


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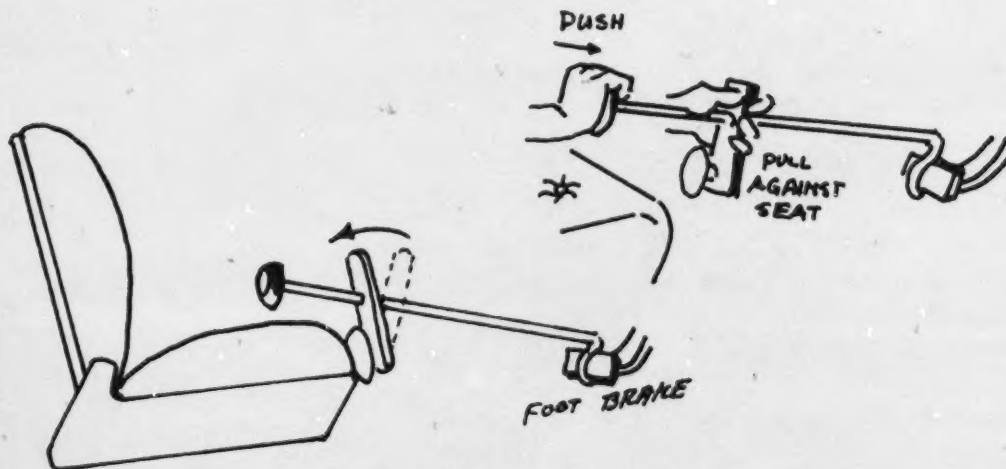
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Check for worn parts by shaking wheels vertically and horizontally.



7. Replace worn suspension and steering parts if needed.
8. Lower car on turning radius plates (wheels straight).
9. Install brake pedal depressor to lock four (4) wheels if needed.



10. Attach wheel alignment tester to check for camber of left front wheel.

NOTE: Follow manufacturer specifications.

COMPETENCE - PROCEDURE/STEPS	TEACHING/LEARNING ACTIVITIES
11. Read camber on camber scale using proper template for car. 12. Check camber setting by noting the location of the bubble on the gage. 13. Determine the amount and direction of adjustment required on scale by reading the gage.	
14. Adjust camber to manufacturer specifications using necessary method (see shop manual). 15. Complete items 11 thru 17 to right front wheel. 16. Recheck alignment specifications.	

COMPETENCY: Adjust Toe In (Wheel Alignment)

COURSE: Automotive Body and Fender

UNIT IV: Frame Work

OBJECTIVE: The student will be able to adjust toe in

Page 1 of 2 pages

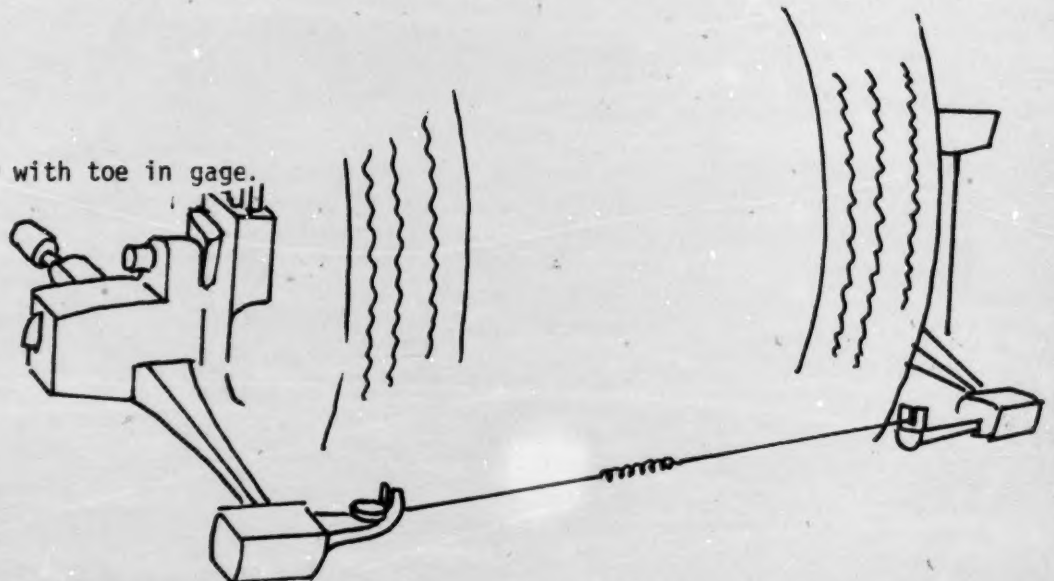
COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
--	------------------------------

1. Proceed from caster alignment.
2. Center and lock steering wheel.



INTRODUCTION: Toe in is the amount, in fractions of an inch, that the front wheels point inward. If the front of wheels are closer together than the rear of the wheels they are said to have toe-in. To offset widened tolerances in the steering linkage and to keep the wheels running true, a small amount of toe-in is required. Incorrect toe-in causes excessive tire wear.

3. Check car with toe in gage.



4. Check manufacturer's specifications.
5. Adjust toe in if needed.

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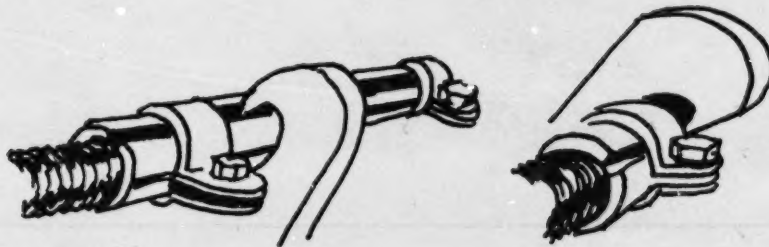
COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

6. Loosen bolts on the rod sleeves--
R & L if needed.



7. Turn adjusting sleeve in or out to
get proper adjustment.



8. Secure tie rod sleeves.

9. Check alignment specifications.
10. Clean up area.

COMPETENCY: Hone a Cylinder

COURSE: Automotive Body and Fender

UNIT V: Hydraulics

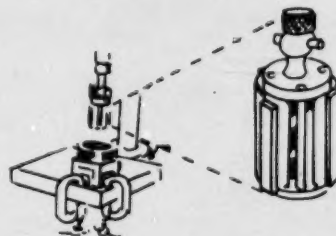
OBJECTIVE: The student will be able to restore a cylinder to usable dimensions

Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS The student will be able to:	TEACHING/LEARNING ACTIVITIES
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1. Clean cylinder at top and bottom to remove burrs and pieces of base and head gaskets.
2. Fasten the cylinder to a heavy iron or steel plate and skim the block to make the top of the cylinder level with the plate.
3. Set the plate and cylinder on the drill press table.
4. Place and tighten up the hone drive shaft into the chuck of the drill.
5. Slip the hone into the cylinder and connect the drive shaft to the hone and set the stop on the drill press so that the hone can only extend $\frac{3}{4}$ " to 1" from the top or bottom of the cylinder
6. Place the hone in the middle of the cylinder and then tighten the adjusting knob until the stones fit snugly against the cylinder wall. DO NOT FORCE!
7. Lubricate hone as recommended by the manufacturers.

NOTE: If using a portable electric drill, set the plate and cylinder on the floor.



NOTE: If using a portable drill, place a wooden block inside the cylinder as a stop for the hone.

COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

8. Start the drill (300-700 RPM) and as the hone opens, move it up and down rapidly (50 strokes/minute) at the lower end of the cylinder. As the bottom of the cylinder becomes honed, gradually increase strokes until the hone travels the full length of the bore.
9. Stop hone as cutting tension decreases and tighten adjusting knob, relubricate and continue honing until a cross hatch pattern appears to insure proper lubrication and ring break-in.
10. Clean cylinder with solvent and dry thoroughly.



NOTE: Do not extend the hone more than $\frac{3}{4}$ " to 1" past either end of the cylinder bore.

NOTE: Check bore every 30 or 40 strokes for size and straightness.

COMPETENCY: Set Up and Light Prestolite Torch

COURSE: Automotive Body and Painter

UNIT VII: Radiator Repair

OBJECTIVE: The student will be able to set up and operate a Prestolite torch in a safe sufficient manner

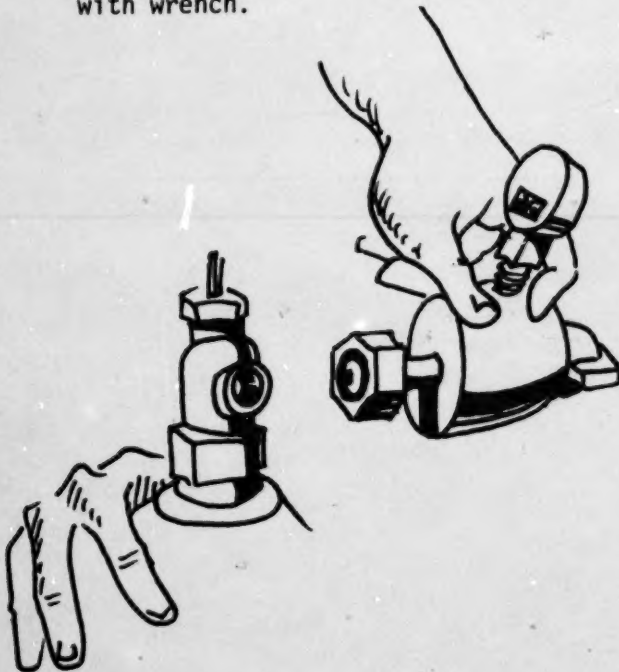
Page 1 of 2 pages

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

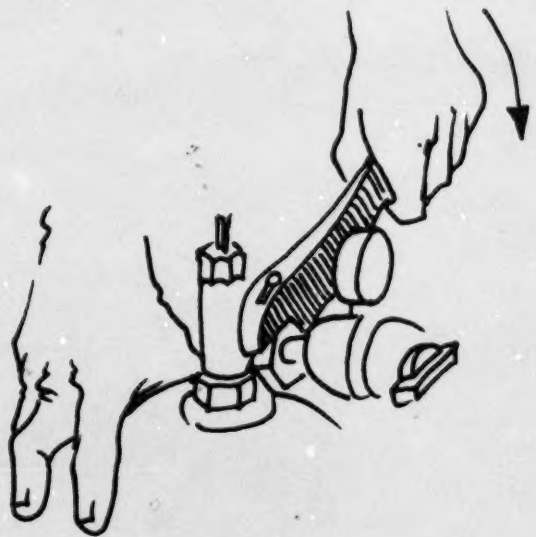
TEACHING/LEARNING ACTIVITIES

CONNECT THE OUTFIT

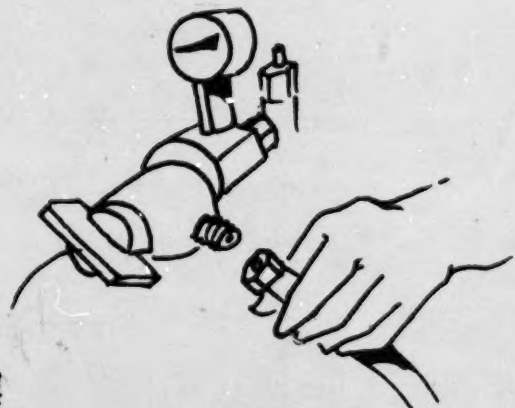
1. Attach regulator to tank and tighten nut with wrench.



2. Attach hose assembly to regulator and handle and tighten nuts with wrench.



3. Attach stem to handle and tighten the connection nut with fingers.



COMPETENCE - PROCEDURE/STEPS

TEACHING/LEARNING ACTIVITIES

LIGHT THE TORCH

1. Making sure both the main valve and pilot valve on the torch handle are closed, open the tank valve one turn.
2. Set the pressure-adjusting screw for the approximate pressure desired.
3. Open the torch handle shut off valve, light the flame using a friction lighter, then readjust the regulator pressure-adjusting screw to get the desired flame size.

NOTE: Always use a Prestolite tank key - not pliers - and leave the key on the valve.

SHUT OFF THE TORCH

1. Close the tank valve.
2. Close the shut off valve on the torch handle.

NOTE: The shutoff valve on the torch handle may be used to shut off the torch for short intervals, up to half an hour.

OPERATION SHEET
SC-7-2

COMPETENCY: Soft Solder with a Torch

COURSE: Automotive Body and Fender

UNIT VII: Radiator Repair

OBJECTIVE: The student will be able to become familiar with flame heat for the purpose of soft soldering

Page 1 of 1 page

COMPETENCE - PROCEDURE/STEPS
The student will be able to:

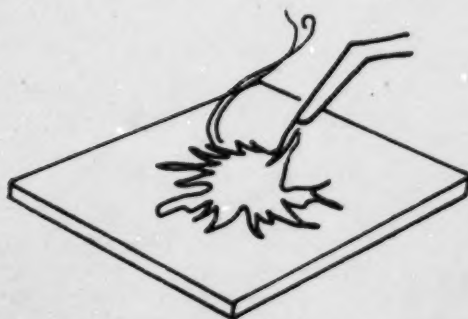
TEACHING/LEARNING ACTIVITIES

1. Thoroughly clean area to be soldered and apply appropriate flux.



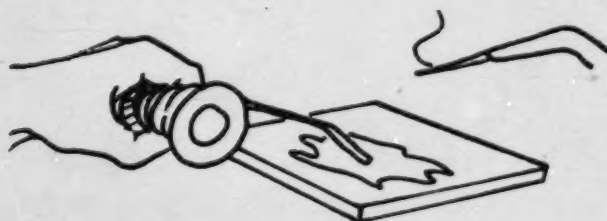
2. Apply torch flame to area to be soldered.

NOTE: Avoid concentrating flame directly on immediate area to be soldered. Apply heat around area so that area will be heated but a minimum of oxidation will occur on fluxed area.



3. Test for correct temperature occasionally by removing flame and touching fluxed area with solder.

NOTE: When sufficient temperature is attained solder will flow onto heated area.



REMEMBER: Solder flows toward the heat so if you want more solder in a particular location, apply more heat there, then add solder.

TITLE: General First-Aid Practices

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

In case of accidents resulting in injury, the following first-aid procedures should be followed carefully:

1. Report the accident to the instructor immediately.
2. Obtain first-aid for every injury, no matter how slight. To neglect a cut or a scratch is to invite infection. Wounds that do not bleed are often the first to become infected.
3. Unless it is absolutely necessary, do not move the injured person until you are sure of the amount of injury.
4. In case of a deep puncture wound, send the patient to the doctor at once. Puncture wounds improperly treated may lead to lockjaw.
5. Do not attempt to remove foreign bodies embedded in the eyeball.

TITLE: Safety Relating to Oxyacetylene Welding Page 1 of 2 pages
COURSE: Automotive Body and Fender UNIT I: Metal Work

A competent welder is one who knows the safety precautions, as well as the technical aspects of his trade. A careless welder is a hazard to himself and everyone near him. It is, therefore, vitally important that the student welder become thoroughly familiar with the safety rules which follow:

1. Keep equipment away from furnaces, radiators, open fires, sparks, grease and oil.
2. Under no circumstances should acetylene be used beyond a 15 pound working pressure.
3. Never weld without proper goggles and gloves, where necessary.
4. Always close cylinder valves before moving cylinders.
5. Always shut off torch when finished welding.
6. Never weld a closed container or one used to hold grease, gasoline or oil.
7. Stand to the side of cylinder when "cracking" the cylinder valve.
8. Before you start welding, be prepared to put out any fire promptly with extinguishers or water.
9. Never use worn or faulty hoses.
10. Keep torch flame away from hose, regulators and cylinders.
11. When lighting the torch direct the flame downward or in a safe direction.
12. Always mark empty cylinders "MT".
13. Always use wrench furnished with the apparatus.
14. Always use the striker to light the torch.
15. Always keep acetylene cylinder wrench in place on the cylinder valve when using the apparatus.
16. Trace leaks with soapsuds or leak detector ONLY!
17. Replace valve protector cap on empty cylinders.

18. Open all cylinder valves slowly.
19. Never place cylinders where they might become part of an electric circuit.
20. Cylinders must always be fastened securely to keep them in an upright position.
21. Never open acetylene cylinder valves more than two turns.
22. Keep cylinders with valve end up.
23. Remember all metal on the welding table is hot until you have tested it. Don't burn your fingers.
24. Never watch a welding operation without eye protection.
25. Never drag cylinders over a cement floor.
26. Never weld or cut on or over flammable materials.
27. Most accidents are caused by the conduct of people. Do not engage in "horseplay" when using welding apparatus.

TITLE: How to Select and Use Fire Extinguishers Page 1 of 1 page
COURSE: Automotive Body and Fender UNIT I: Metal Work

All auto body shops should be provided with an ample number of fire extinguishers. Everyone should be familiar with their location and the owner or manager of the shop should make it his personal responsibility to check the fire extinguishers regularly to be sure they are in operating condition. Remember that water cannot be used to extinguish a fire from lacquer, thinner, gasoline or grease. For such fires a dry chemical or foam type extinguisher is specified. If nothing else is available, sand can be used.

As a further protection against fire, oil and paint rags, together with used abrasive paper, should be kept in suitable containers. Care must be taken so that spontaneous combustion does not occur.

The three general classes of fire are:

1. Ordinary combustible - wood, paper, cloth. Type of extinguisher to use - soda-acid, stored-pressure water.
2. Flammable liquids - gasoline, oil, grease. Type of extinguisher to use - foam type, dry chemical type.
3. Electrical fires - Type of extinguisher to use - liquified gas and dry chemical.

TITLE: Oxygen and Acetylene Gas

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Acetylene Gas:

Acetylene is made from calcium carbide which is a gray substance obtained by smelting coke and lime in an electric furnace. When carbide is dropped into water, a chemical reaction takes place: bubbles of acetylene are given off and rise to the surface. This gas has a peculiar odor and when ignited burns with a smoky and sooty flame. Since acetylene burns and like other combustible gasses, forms an explosive mixture with air, it is evident that safety precautions should be followed while using it.

Oxygen Gas:

About one-fifth of the air is oxygen gas, which can, by suitable means, be extracted. Oxygen is commercially produced from air by the liquid air process.

There are a number of other methods by which oxygen can be produced, but the cost price, the quantities consumed, and the purity desired make it necessary to use the atmospheric and the electrolytic processes. Extraction of oxygen from the air can be readily accomplished when the air is brought to a liquid state. The purity of the oxygen depends upon the successful separation of the oxygen from the other gases which the air contains, the balance being mainly nitrogen gas.

If an electro-current is passed through water under the right conditions, it will cause the water to break up into two gasses--oxygen and hydrogen. The apparatus used for this purpose is so arranged that these gasses are carried through individual pipe lines into separate gas holders, and then compressed into cylinders.

Oxygen obtained through the electrolytic process is used in the same way and for the same purpose as oxygen abstracted from air.

The oxygen used for welding purposes is pure oxygen. It is important to remember that pure oxygen under pressure is an active substance. It will cause oil and greasy materials to burst into flame with almost explosive violence. Remember this at all times when using oxygen. Take all precautions to keep oil and grease away from oxygen cylinders, regulators, and welding equipment. Never confuse oxygen with compressed air.

TITLE: Cylinder Size and Construction

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Oxygen Cylinders:

Oxygen used for welding and cutting purpose is shipped from large oxygen producing plants and marketed in steel cylinders of 100 and 200 cubic feet capacity.

When this oxygen is received for use by the welder, it is under pressure of approximately 2000 pounds per square inch at 70° F. In order to be sure that these cylinders will withstand this terrific pressure, they are made of drawn steel without seams and tested by hydraulic pressure to 3360 pounds per square inch by the manufacturer and periodically thereafter.

Each cylinder is equipped with a high pressure valve protector cap. A safety disc and fusible plug assemble in the high pressure valve is designed to relieve the cylinder of its contents in case it is subjected to over-heating or excessive pressure from any cause.

The valve protector cap must accompany the cylinder and be screwed in place when handling or shipping the cylinders. This is a highly important requirement and should be observed by all concerned in any way with the handling and transport of oxygen or other gases under pressure.

Oxygen cylinders should be handled with care to avoid dropping. Oil and grease must never be used on oxygen cylinders or valves and avoid exposure to furnace heat, fire, and sparks from torches.

Oxygen cylinders are lettered to indicate their capacity. The designation "Q" indicates a cylinder of 60 cu. ft. capacity, and "S" indicates 150 cu. ft. capacity.

Acetylene Cylinders:

For portable use, acetylene gas is marketed in steel cylinders of various capacities. This is the most convenient way of handling smaller quantities of acetylene.

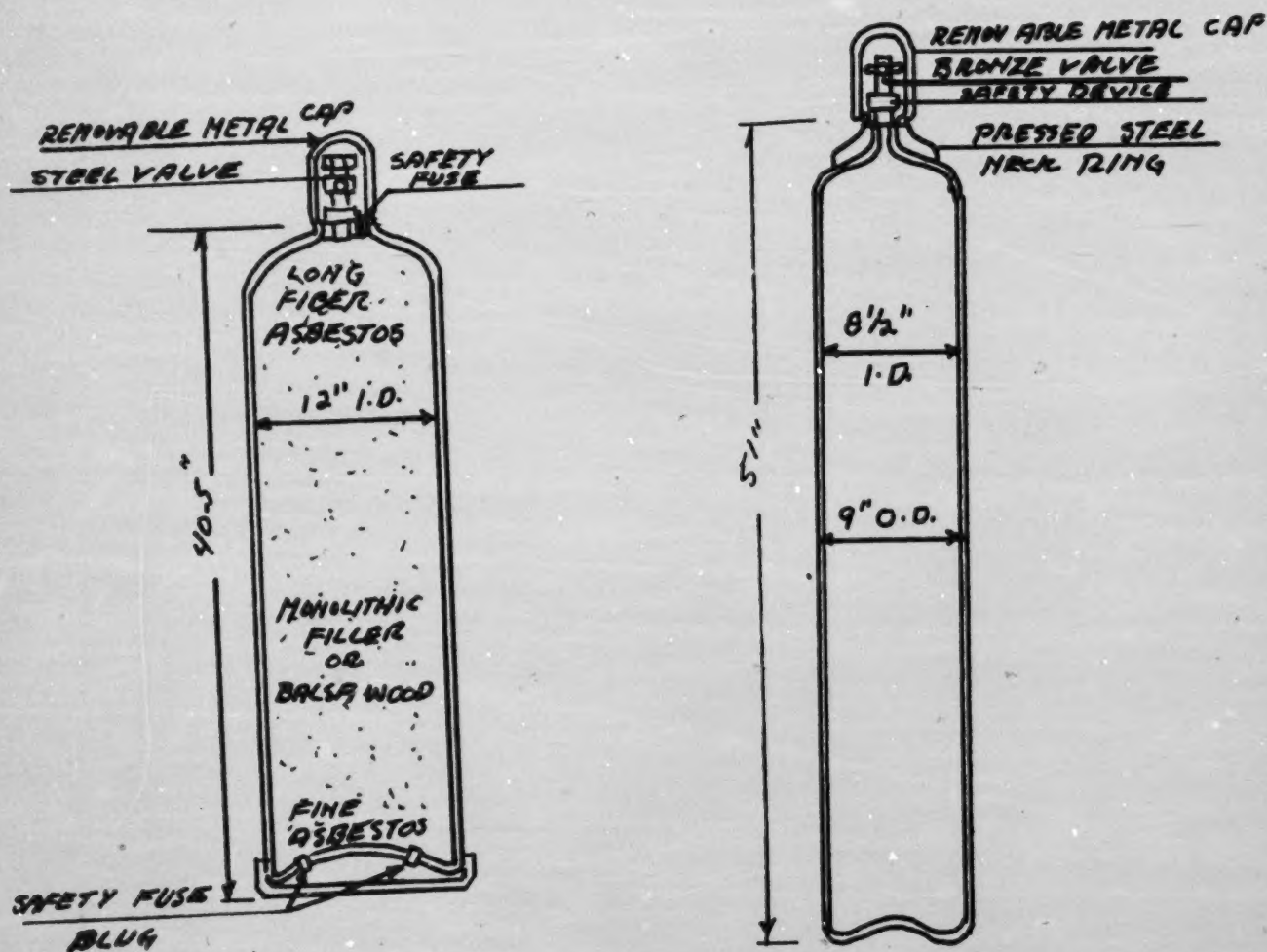
The gas is compressed into the steel cylinders at the charging plants or distributors under about 250 pounds per square inch pressure at 70° F. These cylinders are not empty tanks, as oxygen cylinders are. Instead, they are filled with a porous substance which resembles cotton or mineral wool. This filler is very absorbent and is saturated with acetone. The compressed acetylene is dissolved in the acetone.

The acetylene cylinder is fitted with a high pressure valve, valve protector cap and fusible plugs to relieve over-pressure. The fusible plugs will

melt at the temperature of boiling water, 212° F. Acetylene cylinders require special care in handling. They should never be bumped or dropped and should be protected from open flames, furnaces, and other forms of heat.

Cylinder caps must be replaced when cylinders are shipped or moved around, and when the cylinders are discarded. This is a very important point and must be observed by all concerned in any way with the transportation and handling of acetylene cylinders. When empty, the cylinder should be marked "MT" with chalk.

Acetylene cylinder sizes are: WA size-80 cu. ft. and WS size - 130 cu. ft.



TITLE: Types of Oxy-acetylene Torches

Page 1 of 2 pages

COURSE: Automotive Body and Fender

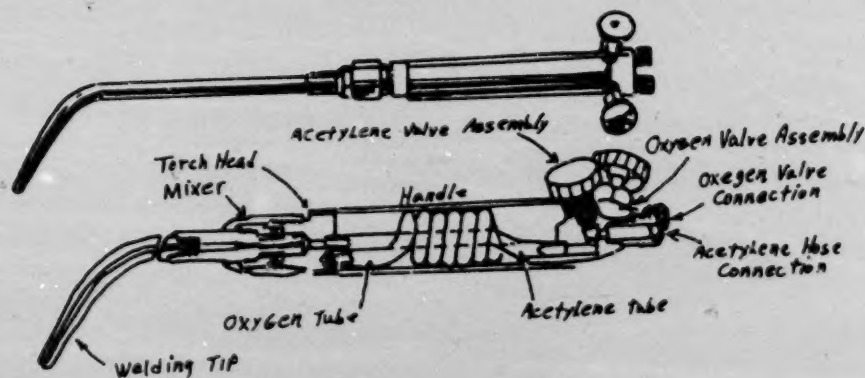
UNIT I: Metal Work

The oxy-acetylene hand welding torch is a tool designed for mixing oxygen and acetylene gases in nearly equal volumes and burning the mixture at the end of the tip.

A welding torch or "blowpipe" as it is sometimes called, has a tubular brass handle which forms a chamber in which the gasses are mixed.

Valves in the handle control the mixing of the gasses before they issue from the tip of the blowpipe. These torches may be obtained in several sizes and with different sizes of flame can be obtained for welding the various kinds and thicknesses of metals.

These torches are precision tools designed and constructed after careful study and should be treated as such. There are many types and designs of torches. However, all torches fall into two basic categories: injector type and medium pressure type.



The other type of torch used with the oxy-acetylene equipment is the cutting torch, designed to cut metals from sheet metal gage up to 15" thick, in larger welding/cutting shops. The cutting torch has a preheat flame which heats the metal prior to its being cut, and an orifice to deliver a steady stream of pure oxygen to blow the molten metal away and make the actual cut. The preheat flames are adjusted to a neutral flame just as the regular welding flame is, except that there are usually four preheat flames on a cutting torch. A special "trigger", sometimes called a "cutting lever" or "oxygen lever" is supplied. Depressing or pulling this trigger allows the oxygen stream to flow through the center orifice of the cutting torch and cut the metal by blowing it away.

TITLE: Welding Flames and Their Uses

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Satisfactory welds can only be made when the flame used is of the correct heat. This is accomplished by mixing the oxygen and acetylene in the right proportions. It has been found that changing the proportion of oxygen and acetylene with respect to each other will produce one of three types of flames. These three types are:

- a. carbonizing or excess acetylene flame

carbonizing
(Excess Acetylene)
Flame

Inner Cone Intensely Bright



- b. neutral flame or properly mixed flame

Neutral Flame

Acetylene "Feather" (Whitish Color)



- c. oxidizing or excess oxygen flame

oxidizing
(Excess Oxygen)
Flame



Inner Cone Becomes Shorter
Flame Becomes Noisier

The proper welding flame is known as the "neutral flame" and it is very essential that the welder thoroughly understands the flame adjustment and takes care to maintain a neutral flame when welding.

The Neutral Flame:

When approximately equal volumes of oxygen and acetylene are burned at the tip of the blowpipe, the flame is said to be "neutral."

The highest possible temperature is obtained with the "neutral flame" which is about 6300° F. The hottest point of the flame is just past the end of the inner core.

In order to obtain the best results for heating, the flame is held perpendicular to the metal with the end of the inner cone about one-fifth of its length away from the object.

Carbonizing Flame:

If the volume of acetylene is increased (or the oxygen decreased) a carbonizing flame will result. The excess acetylene in this flame is indicated by the feather edge extending beyond the inner cone. Even a slight trace of this feather at the end of the inner cone shows the flame is a trifle carbonizing. When the acetylene is decreased so the feather just disappears the flame is really neutral. If the flame has an excess of acetylene, it will carbonize the metals because molten iron and steel absorbs carbon rapidly. This causes the weld to become hard and brittle.

Oxidizing Flame:

When the volume of oxygen is increased (or the acetylene decreased) the flame becomes an oxidizing flame. It is indicated by a shortening of the inner cone which then takes on a purplish color.

This type of flame is sometimes used when bronze-welding steel, and other metals. A heavy oxidizing flame is sometimes used for welding brasses or bronzes containing a small amount of tin or lead.

If the welding flame has an excess of oxygen, it will oxidize steels or cast iron and thus change the composition of the metal.

TITLE: Welding Equipment and Material Costs

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Representative costs of various welding equipment items listed below.

1. Two Stage Oxygen Regulator	\$ 52.50
2. Two Stage Acetylene Regulator	50.50
3. Welding Torch Mixer	25.00
4. Welding Tips - Sizes 1, 3, 5, 7, 9	@ 14.10
5. Hose, 20 ft. long	13.50
6. Welding Goggles	5.30
7. Spark Lighter	2.35
8. Wrench, Cylinder and Regulator	2.50
9. Cutting Attachment	36.00
10. Acetylene Tank	90.00
11. Cutting Tip, No. 2	10.00
12. Oxygen Tank	100.00
13. Welding Cart	30.80

(1974 prices)

These prices will vary according to the type of equipment and the distributor from whom the equipment was purchased.

Keep these prices in mind when you are welding or cutting.

TITLE: Regulator Function and Construction

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Welding with the acetylene torch is the process of fusing metal with a high temperature flame produced by burning acetylene gas with oxygen in the ratio of one volume of oxygen to one volume of acetylene gas.

Since welding gasses come to the welder in cylinders under terrific pressure they must first be reduced to a workable pressure, a pressure regulator is necessary and must be attached to the cylinder valve before the gas can be used.

Pressure regulators are instruments which are designed to reduce the gas pressure flowing from the cylinder to a desired working pressure and maintain that pressure during the welding operation.

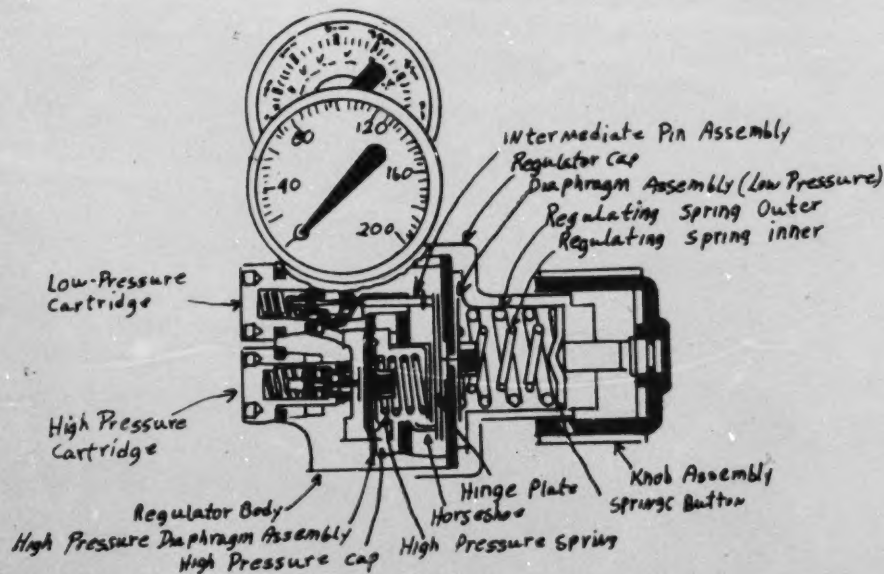
A separate regulator on each cylinder is necessary. Each regulator has two gages, one is a high pressure gage, and the other a low pressure gage.

The regulator used on the oxygen cylinder has a 3000 pound high pressure gage and a 50 pound low pressure gage.

The regulator used on the acetylene cylinder has a 350 pound high pressure gage.

The low pressure acetylene gage usually registers 30 pounds working pressure, but it is graduated only to 15 pounds. Acetylene is never stored at pressure above 15 pounds per square inch.

The two types of regulators are the single-stage and double-stage, as pictured. Our regulators are double-stage.



TITLE: Welding Protective Devices and Dress

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

The operator should dress in appropriate clothing for welding. A one-piece loose-fitting overall suit with cotton waistband and close-fitting collar is recommended. A gauntlet type glove of good quality with properly fitted and extending length of two or three inches above the wrists to protect the hands and forearms from the heat.

High laced shoes with thick soles and sound uppers are desirable to prevent burns from flying sparks and molten metal.

Head covering is optional. Many welders wear a thin cloth cap, and turn the visor around to protect the back of the neck.

Thin clothing or knitted garments such as sweaters should never be worn while welding. Sparks and hot slag cling to knitted garments and because of the operator's interest in his work he sometimes does not discover that his clothing has become ignited in time to prevent severe burns.

The operator must guard himself against two kinds of burns. First, the contact burn which is caused by coming directly in contact with hot metal; and second, the radiation burn caused by the heat which radiates from the hot metal.

Gloves worn should be made of a very high wear-resisting material and not easily burned. Common untreated cotton fabric gloves are dangerous and should never be worn when welding. Gloves made of asbestos are recommended.

Goggles must be worn to protect the eyes. Several types are made but the kind giving the greatest amount of protection is known as the fully cupped type. This type fits snugly against the face on all sides and prevents flying sparks from reaching the eye. The maximum protection to the eye from the flame is given by the colored lenses of the proper shade. These lenses still permit the operator to see his work. Cupped goggles are also constructed with a fine mesh screen on the temple side of each cup which provides ventilation and prevents clouding on the inside of the lenses caused by perspiration. Although the welding flame contains very little ultra-violet rays, the eyes should be protected.

TITLE: Types and Sizes of Welding and Spelter
Rods

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COURSE: Automotive Body and Repair

UNIT I: Metal Work

In making a weld additional metal is sometimes needed. This additional metal is needed to strengthen the weld or to act as a filler to build the welded joint up to a desired height or shape. This filler metal may be obtained in rod form in many shapes, sizes, and of many different kinds of metals and alloys such as:

1. Mild steel rods - for welding steel plates, sheets, and structural steel, pipe, etc.
2. Cast iron rod - for welding gray iron castings.
3. Bronze rod - for general bronze welding and brazing.
4. Drawn manganese bronze rod - for building up bronze surfaces on cast iron and steel as well as bronze castings that are subjected to wear.
5. Cast silicon-aluminum alloy rods - for welding automobile crank cases and all aluminum castings.
6. Drawn aluminum rods and wires - for welding sheet aluminum and all rolled and drawn aluminum products.
7. Nickel sheet rods - a nickel alloy for welding nickel steel and other alloy steels when higher strength is required.
8. Vanadium rods.
9. Chrome-vanadium rods.
10. Drawn copper rods.

The selection of the filler rod depends entirely on the kind of metal or alloy being welded.

Filler rod is added by melting it into the molten puddle of metal as the weld is being made.

Almost all welding rods are round and the size is determined by measuring the diameter of the welding rod, not including any coating. As a general rule, use small diameter welding rods for light-gage metals, and larger diameter welding rods as the metal thickness increases.

TITLE: Types and Uses of Welding and Brazing
Fluxes

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COURSE: Automotive Body Repair

UNIT I: Metal Work

Some metals do not fuse readily; they do not flow together and unite. To overcome this problem a flux is used.

A flux is a combination of chemicals in powder form which assist in fusing the metal and in raising the oxides to the surface of the weld. A flux is really a deoxidizer.

Fluxes are used in welding cast iron, brass, bronze, aluminum, nickel, and other such alloys.

Non-ferrous metals are metals that are not alloyed with iron.

Each metal requires a different flux. In welding sheet aluminum, the formation of oxide is very rapid and therefore a special flux must be used to overcome this condition. Fluxes also help to float away dirt and slag. They should be used very sparingly, as a little in the right place goes a long way.

The flux should be applied by dipping the heated filler rod into the flux as it is required.

Flux containers should be kept closed when not in use. Most fluxes lose their strength when exposed to the air. A defective weld may result from using weak flux.

TITLE: Arc Welding Safety
COURSE: Automotive Body Repair

Page 1 of 1 page
UNIT I: Metal Work

Before using the arc welder you should know certain precautions and information about operating and handling your equipment, accessories and tools. To do the job easily, properly and safely, there are some simple rules to observe.

1. Understand your welder - review the operator's manual.
2. Keep welding accessories in good condition. Use cables of adequate size, check for breaks and keep ground fastened securely.
3. Wear good protective equipment - gas welding goggles are not adequate protection. Good gloves, welding aprons and high shoes will protect you from spatters and sunburn of the arc rays.
4. Remove flammable materials from the welding area before starting to weld.
5. Do not weld empty used containers unless you know what they were used for.
6. Treat cuts or burns promptly.

TITLE: Welding Machines

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

The success of welding as a metal joining process rests on the fact that a good weld is stronger than the plate in which it is made. Arc welding requires a continuous supply of electric current, sufficient in amount (amperes) and of proper voltage to maintain an arc. Several types of welders are available, alternating current, AC, and direct current, DC, and a combination of AC and DC machine.

The AC transformer machine is often used in the automotive body and fender repair shops. As they operate on single phase power and meet most of the needs for automotive repair work.

The AC transformer machine has basically two different types of current control systems. One is a continuous crank operated control. The second type is a control in which the electrode leads are plugged into different jacks, or stops, to obtain different settings. With either type the operator can select the welding heat he wants.

CAUTION

Be sure to check with the power company before purchasing a machine to insure availability of needed power for the machine.

TITLE: General Information on Arc Welding

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

1. Arc welding is the process of melting and fusing pieces of metal together. The flow of an electric current jumping the gap between an electrode and the piece or pieces being welded creates the arc that melts the metal.
2. Terms used in arc welding:
 - a. Welder - the man or person
 - b. Welder - the machine or piece of equipment
 - c. Arc Welder - is a device that makes it possible to convert electrical energy into heat energy.
 - d. Amperage Setting - is that setting which a welder selects for a specific weld which will vary according to several factors: thickness, size of metal, type of joint, size of electrode and the type of electrode.
 - e. Arc - to scratch the rod like a match and the rod must not be lifted too far away from the basemetal at the end of the stroke or the newly established arc will be extinguished.
3. The actual procedure for setting a particular welding machine to the desired current is described for each machine. Before you can set the machine, you must first know how much welding current you need.
 - a. First select an electrode. A general rule of electrode section is that the electrode diameter should not exceed the thickness of the basemetal. This rule is only the starting point.
 - b. Welding speed is the largest factor in welding costs. Use the largest electrode and greatest amperage possible.
 - c. Position of welding - 3/16" electrode is maximum size for good puddle control in vertical, horizontal and overhead welding.
 - d. Joint preparation - reaching the bottom of a narrow vee may prevent the use of larger electrodes on first pass.
 - e. Fit up - burn - through may occur with large electrodes on first pass. Back up strips permit larger electrodes to be used.
 - f. Machine capacity - amperage rating on machine may not be sufficient to use largest electrode possible for a given job.
 - g. For any given size of electrode, there is an amperage range specified by the manufacturer.
4. The amperage, electrode size and travel rate all effect the location, amount and shape of bead buildup. Adequate buildup of a bead is one essential factor insuring that the bead is stronger than the metal on either side of the weld.

5. The arc length, electrode angle, amperage and welding voltage are all factors contributing to the control of penetration. Penetration is particularly critical when metal being joined is to be subjected to any type of bead test or is subjected to flexing during use.
6. The travel direction is controlled by the way the weldor holds his electrode holder. A right-handed weldor grips the electrode holder in his right hand and runs beads from left to right. The left-handed would be the reverse.
7. It is essential that the beginning welder learn to strike an arc, preheat the beginning and end of a bead, and finish a bead properly.

TITLE: Electrodes

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

E6011 and E6013 electrodes differ in several ways; these differences suggest some variations in the method used to weld them:

1. The fluxcoating on E6011 electrodes is cellulose rather than mineral. It is made from wood flow which indicates how fine the wood or cellulose has been ground.
2. It takes less heat to melt or burn the cellulose coatings; therefore, it takes less amperage to weld with #6011 electrodes than with the same size electrodes with a mineral coating.
3. It is important to recognize that all #6011 electrodes do not have the same resistance to current flow; thus, some E6011 electrodes have different welding voltage requirements. Small shop A.C. Welders are known as low-open-circuit-voltage (O.C.V.) machines and E6011 electrodes that have low O.C.V. requirements should be selected for use with them. E6011 electrodes that have high voltage requirements because they have high resistance to current flow will be difficult, if not impossible to use. A weldor will find it very difficult to strike or maintain an arc with them.
4. The cellulose coating or flux on E6011 electrodes is consumed during welding to the point that there is very little slag covering the weld. The small amount left will be black and charred looking. Compared to the mineral type flux residues, E6011 slag may be a little more difficult to remove.
5. The redeeming features of #6011 electrodes are the high quality welds produced, the low bead profile, and the quick-freeze nature of the weld crater. A crater that freezes or angles rapidly is especially desirable for welding in positions and joints where slow cooling weld craters would run or drip; for example, a horizontal bead on metal positioned in the vertical plane.
6. Iron power electrodes, a relatively new product, are designed to speed up welding, but they also provide an aid for the welder in controlling arc length. The lower portion of the lip formed by the slow-melting flux coating may be used to support the electrode during welding. The iron power electrode must be inclined at an angle of 45° to 55° when used as a contact electrode. The contact position will require 10 to 30 amperes more current than the conventional position because some heat is reflected away from the head due to the low angle. The purpose of the extreme electrode angle is

to prevent the upper flux lip from smothering the arc and causing turbulence of the pool or crater. If a low angle were not used during contact position welding, the slag and the gases released would be forced into the weld metal. Slag inclusions and gas pockets weaken the weld, causing failure in use or in testing. Iron power electrodes may, and frequently are, used upright, like conventional electrodes. The weldor must then control the arc length without depending on the flux lip. The electrode should be held at an 80° to 85° angle.

TITLE: Spot Welding

Page 1 of 6 pages

COURSE: Automotive Body and Fender

UNIT 1: Metal Work

Instead of having a continuous weld to join two pieces of sheet metal together, welding in spots less than an inch apart is quicker and less expensive. Such welding is used in largely production work. It is often used to weld sections of the body together (sections adjacent to each other). This is also used to repair and replace automobile body sections. The equipment used is of a portable type and is designed for use in any position and on any seam which was originally welded by a resistance spot welder.

(NOTE): The metal panels edges must be very close together and clean to be able to produce a good spot weld.

OPERATING INSTRUCTIONS PANELSPOTTER RESISTANCE WELDER

Your Panelspotter can save you more money than any piece of body shop equipment you now own. Panelspotter brings to the collision shop the same high speed welding method used by Detroit's Automakers. Quarter panels and patch panels can be completed in about half the normal time with distortion, gas or welding rods. The spot welded joint is so true to original body contours that only about 40% of usual amount of body filler is required for finishing. Add up these labor and materials savings and the Panelspotter will pay for itself in about 4 months for the average shop.

HOW TO GET THE MOST OUT OF YOUR PANELSPOTTER

Hook-up

Bolt the cable lugs to the welder studs, make sure bolts are tight, insert the 3 prong control line plug into the receptacle on the front panel. Plug welder input cord into any 230 volt, 60 cycle, single phase, 60 amp fused receptacle such as an arc welder outlet. If you do not have such an outlet, call a qualified electrician. Be sure supply line is large enough to prevent voltage drop.

Operation and Procedures

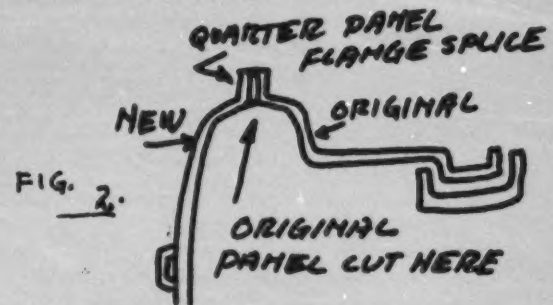
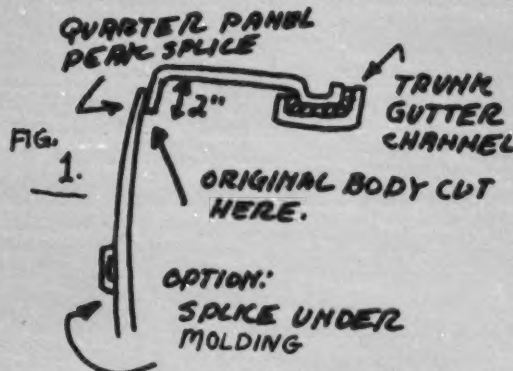
Panelspotting involves 3 easy steps to panel installation:

- 1) Cut away damaged section
- 2) Prepare weld seam
- 3) Panelspot it

Cutting Away Damaged Area - Select the easiest place to splice the new panel (at the peak edge, underneath the molding strip, or all the way to the trunk gutter rail - if necessary). Cut away damaged area with a good cutter in order not to physically distort the edge (an air tool with a crow foot bit is excellent). Skin the paint off car body down to bare metal with a disk grinder along the seam to be welded. Cut the replacement panel to overlap the original body stock by about 2 inches.

Preparation for Welding - Clean metal means good welds. Skin off the prime coat on both sides of the new panel along the weld seam with a small disk grinder. The paint removal area need only be 1/2 inch wide and takes only 10 minutes for the average panel. This short preparation time is all that's needed to obtain the high speed spot welding that cuts installation and finishing time in half. If the panel has a rust preventative film coating instead of prime paint, merely wipe off both sides of the weld seam with a clean rag and some thinner.

Spot Welding Operation - The drawings below show two basic types of welding joints common to almost every panel job.



You can either splice panels or make a full installation all the way into the trunk gutter rail. Panelspotter offers you complete flexibility to install distortion-free panels anyway you choose - depending on what the job calls for.

Figure 1 shows a panel peak splice welded at "A". Since the upper panel section was not damaged, the peak splice is easily spot welded and finished. The same splice operation can often be done at the molding too. If the upper panel had been badly damaged, the replacement panel could be installed as a unit all the way to the trunk gutter rail and spot welded at "B".

Figure 2 is a flange type joint welded at "C" which shows how a lower body panel can easily be joined to an undamaged inner section. Use Vice-Grip pliers to hold panel in place and spot weld close to Vice-Grip jaws where the fit-up is tight. Move Vice-Grips along as you go or use enough to clamp panel every 6 inches.

IMPORTANT GENERAL INSTRUCTIONS

1. Electrode Tips

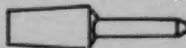
Two types of tips are supplied with your Panelspotter:

Standard Tips



Part No. A 144

Special Tips



Part No. A 145

Standard Tips are to be used for every possible application because they have a bigger cross-section and will give longer life. Most panel jobs offer easy access to the weld joint; therefore you should use these tips 95% of the time.

Special Tips should be used only for spot welding in trunk gutter rails and other tight places. After completing the job, the Special Tips should be removed and replaced with the Standard Tips.

KEEP TIPS DRESSED TO 1/8 INCH TIP DIAMETER
FOR
CONSISTENT WEIDING RESULTS



It is important to deliver the proper amps per square inch of tip area to the joint. When tips get blunt or rounded, welding efficiency and power is lost. Proper tip diameter insures good welds.

Removing Tips - Tap side of copper electrode holder body GENTLY several times with a bumping hammer to loosen the taper fit. Tips are then normally loose enough to remove by hand but pliers can be used to pull tips out if necessary. Normally, tips should be removed for dressing about every 300 spot welds but you should inspect the tip diameter before each panel job.

Dressing Tips - The fastest way to dress tips is to hold them in your fingers while dressing against a fine grit grinding disk. Rotate tip in fingers until 1/8 inch tip diameter is restored.

Inserting Tips - Wipe taper clean before inserting tips. Check tapered hole in holder body to make certain there is no dirt inside. Press in tips with HAND PRESSURE ONLY - never hammer tips into holder body. Never insert a "cold" electrode into a hot

holder body. You should be able to hold copper holder body with bare hands before inserting a cold tip.

If by accident you should burn a hole in the panel, it is likely that some steel will fuse to the copper electrode tips. Remove the fused steel by nipping the tip ends with pliers or diagonal cutters.

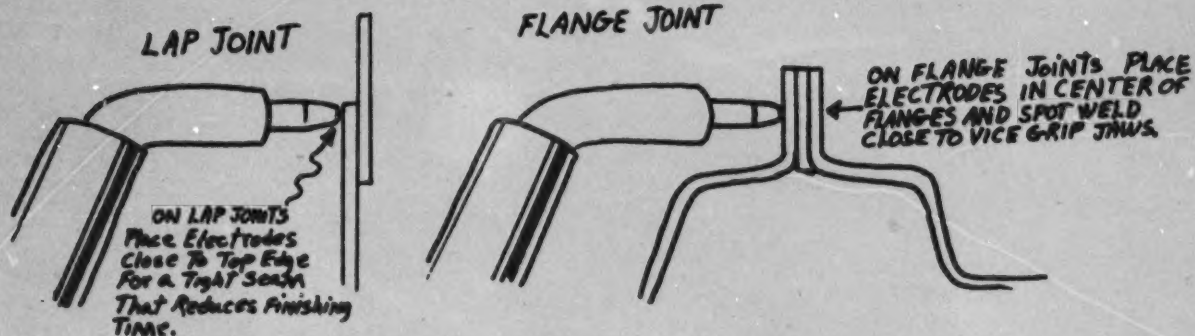
Tips will normally last about 10 months to a year.

2. Cable Connection - Keep bolts tightened at welder cable connection. Good contact means good welds.
3. Welder Capacity - Panelspotter is designed to spot weld automotive gage body metal - 20 gage material. This is the area where the major part of today's auto body shop costs are involved. Although the Panelspotter will weld heavier stock - up to 18 gage - the welder should not be used for welding thicker sections such as auto frames and floor pans. It is only the metal thickness of the top piece that governs capacity. The bottom sheet or piece of metal that you are welding to can be any thickness.
4. Duty Cycle - Panelspotter has a built-in safety warning to let you know when the duty cycle rating has been reached. When the fibre handles get too warm to hold with the bare hands, let the welder rest for a short period. This will not occur until you have done a considerable amount of welding in rapid succession. It is normal for the cables to become warm after doing a panel.
5. Helpful Welding Hints - Use Vice Grip pliers on all flange joint and drip rail applications to bring parts closely together. Weld near the Vice Grip jaws where the fit-up is tight.

On lap joints, a few sheet metal screws can be used, if desired, to position the panel for spot welding. Make sure paint has been removed from joint.

On long splice jobs, start in the middle of the panel and spot weld in one direction, for example, from the middle of the panel to the door post. Start again in the middle and complete panel welds to the tail light area. This is an additional aid in eliminating distortion.

Removal of burrs on the newly cut panel insures getting good metal-to-metal contact when body pressure is applied to electrodes. Burrs and dents cause an air space between mating parts and prevent positive metal contact.

Best Position of Electrodes for Welding

Door Posts - Most fit-up problems occur where the quarter panel joins the door post; but this can easily be overcome. Use a blunt nosed punch and hammer about a dozen "dents" where the quarter panel lip joins the door post. Then place the electrode tips in these dents and weld. Another help is to use several sheet metal screws to secure the panel lip to the door post when lining up the panel prior to spot welding - then remove the screws after spot welding.

Patch Panels - If patch panels are cut from sheet metal to cover rust areas, be sure to make the patch big enough to extend beyond rusty area into good body metal.

In resistance welding, the output cables are purposely bound together to deliver more power to the weld. If the bands should become cut, tape cables so that they are always bound together.

By checking 4 things: (1) clean metal, (2) good fit-up, (3) proper time setting, (4) correct tip diameter, YOU WILL ALWAYS MAKE GOOD WELDS - PANEL AFTER PANEL.

BURN THROUGH is caused by one of the following:

1. Paint not removed from mating panels
2. Air gaps between mating metal parts
3. Timer setting too long for the thickness of metal being welded.
4. Removal of welding tips from the work before weld cycle has automatically stopped.
5. Tip diameters not equal.
6. Fusing - The Panelspotter must be plugged into a 230 or 208 v., 60 cycle, single phase, 60 amp fused receptacle such as an arc welder outlet. In case the Panelspotter will not operate, first check the main fuse box of the building wiring to see that the main circuit fuses are not blown. If the Panelspotter is not getting power, the red indicator light on the front of the case will

will not operate. After checking the main line fuses, if the Panel-spotter still is not getting power, then remove the bottom panel and check the 60 amp fuses located inside the case. These fuses are plainly visible after the bottom plate is removed. Replace fuses if they are blown. This double fusing of the Panelspotter circuit gives double protection against accidental damage to the equipment or the operator.

TITLE: Safety Relating to Filling
COURSE: Automotive Body and Fender

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UNIT I: Metal Work

Fiber Glass:

Be careful to remove any resin, resin mix, or hardener from skin, clothing, and tools before curing (hardening) progresses. Wash with lacquer, thinner, and then with soap and water. This is important, since failure to remove the resinous compound may cause dermatitis (skin blotches and irritation).

Tinning Flux and Solder:

The fumes given off by the mixture are very toxic. Always prepare the flux where there is plenty of fresh air. Avoid breathing toxic fumes.

If the disc sander is used for sanding body solder, the dust from grinding can be absorbed through the skin as well as breathed into the lungs. Once lead enters the human body, there are no natural means by which it can be eliminated. Enough lead, obtained in any manner over any period of time, will cause lead poisoning. If disc sander must be used on body solder, the operator should have a respirator, and he should wash the lead dust from the skin as soon as possible.

Plastic Fillers:

Keep plastic fillers away from heat and open flame. Store in cool dry place. If air or electric sanders are used to finish plastic fillers, the operator should have a respirator, and he should wash the plastic dust from the skin as soon as possible.

TITLE: Methods of Cleaning for Soldering

Page 1 of 1 page

COURSE: Automotive Body and Repair

UNIT I: Metal Work

Any material must be removed that will prevent the solder from adhering to the surface to which it is to be applied. The materials which, under normal conditions, will be on the surface to be soldered are: (1) paint, (2) weld scale, and (3) rust.

Occasionally body sealers, cements, or other foreign matter which has found its way onto the surface by accident also must be cleaned off. The same cleaning methods will be satisfactory for the removal of all types of material.

The clean, bright metal surface left by the disc sander is ideal for solder application. Wherever possible, use the sander to remove paint, rust, or weld scale. However, some surfaces are entirely too rough to be cleaned with the sanding disc, such as rough welds which are an excellent example. Such surfaces are difficult to clean with the sander because it cannot get into sharp depressions and pits. Turning the sander up on edge to get into the bottom of such spots can cause it to cut away enough metal to weaken the panel but still not clean the surface properly. When this happens other methods of cleaning are needed.

The saucer-shaped wire brush mounted on a disc sander is an excellent tool for cleaning rough spots that cannot be reached with the edge of the sanding disc. Although not satisfactory for removing large areas of paint, it will clean out either paint or weld scale from sharp depressions very rapidly and without contamination. It is best, however, to avoid its use on any surface where cements or sealers are present, because it will smear such materials instead of removing them. Such materials may be removed much more easily by heating them and scraping.

TITLE: Types of Tinning Materials
COURSE: Automotive Body and Fender

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UNIT I: Metal Work

Tinning is the operation of coating with melted solder the surface to be soldered. The body solder operation differs from most other soldering operations in that the tinned surface must be wiped clean before the additional solder is applied.

Flux of some sort is essential for soldering on almost all metals, but particularly so on steel. The flux serves as a chemical cleaner. When applying body solder with the torch and paddle, the flux residue must be wiped off before the filling material is added.

Practically all of the fluxes used for body soldering are liquid; resin, past flux and tinning compounds, which are composed of flux mixed with powdered solder.

TITLE: Soldering Paddles - Sizes and Uses

Page 1 of 1 page

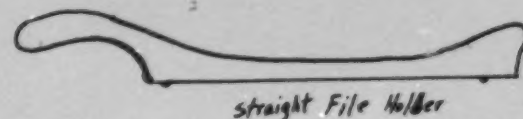
COURSE: Automotive Body and Fender

UNIT I: Metal Work

After the body solder has been applied to the panel, a wooden soldering paddle is used to spread, shape, and smooth the solder. The paddles are made of close-grained, hard maple. Different types and sizes of paddles are required to form the solder around the various contours of body metal.

Soldering paddles should be kept clean and lubricated when paddling the solder. The lubricant prevents the hot solder from sticking to the paddle. It also prevents the paddle from burning and charring, and makes the solder spread smoothly and easily.

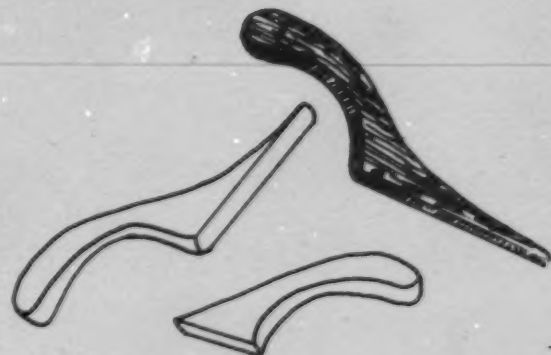
The Straight File Holder - This file holder is for both 12 and 14 inch Vixen Files, including both the regular flat files and the shell or half round type.



The Adjustable File Holder - which is adjustable always and always adjustable. The handle can be adjusted to either side to enable the operator to work close to an offset or other panel without bruising or skinning his knuckles. The handle can be entirely reversed, and again adjusted to either side. It can be used either right or left handed, with the hand entirely out of the way of the work. It permits flexing the file either way to the maximum point of safety against breakage. The bolt which attaches the blade at the rear of the holder should be loosened before flexing.



The Solder Paddle - This tool is made of close grained maple. The well shaped handle fits the hand perfectly. The blade is full size and flat faced so that it may be used "as is" or cut down into any shape desired.



The Refined Button Tallow is recommended for greasing the working face of the paddle while smoothing and shaping the solder.

TITLE: Soldering Paddle Lubricants

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

Lubricants used are beeswax, lard oil, tallow. Some paddle manufacturers boil the paddles in tallow. This saturates the paddle.

A lubricant should be applied sparingly so that excess lubricant is not deposited on the hot solder. If the lubricant is trapped in the solder fill, it may in time work its way out through the fill and blister or peel the paint. After dipping the paddle into the lubricant, lightly play the flame over the paddle face to soak the lubricant into the paddle. It is not necessary to add lubricant to the paddle each time it is used. When the paddle surface becomes dry and the solder starts to stick to it, then more lubricant should be added.

After long periods of usage, the paddle will become charred and rough along the bottom face, and the solder will stick to it. When this occurs, the paddle should be filed smooth with a body file.

INFORMATION SHEET
IL-1C-6

TITLE: Types and Grades of Solder

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Body solder is used to fill patched areas, welds, and areas that cannot be fully straightened because of obstruction by the inner panels and other interferences.

Body solder is an alloy metal. It is made from a mixture of 30 percent tin and 70 percent lead (ratio 30:70). The first figure of the ratio always represents the tin percentage, and the second represents the lead percentage. Lead has good filling qualities but has poor workability and adhesive qualities. Lead melts at 620° F. Tin has a lower melting point, 450° F, and excellent adhesive qualities. When used alone, it is a poor filler. A combination of 30 percent tin and 70 percent lead produces a solder alloy having a plastic range from 361° F to approximately 475° F. At temperatures over 475° F, the solder begins to melt into a liquid.

The solder is mixed (alloyed) and sold by "weight". It is used for filling purposes because of its excellent adhesive qualities. Once it has been applied to steel, it will not crack, chip, or peel off. When filling, it is not necessary to melt the solder. It only needs to be heated to the plastic state.

30:70 solder is the most common grade used.

40:60 and 20:80 are also familiar grades.

40:60 grade has a tendency to leave air holes in the work because of composition of materials.

20:80 is the most desirable but is too expensive for volume usage.

TITLE: Plastic Fillers

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

Plastic fillers are available from a large number of manufacturers. A few have special features which make them different from the rest. Most of them, however, are quite similar in the way they are packaged, prepared for application, and finished. The following description applies to the majority of the materials which are similar, not to the exceptions.

In general, plastic materials are prepared by the manufacturer in two separate containers, the contents of which are mixed immediately before application. The mixing produces a chemical action which causes the material to harden, so that it can be finished smoothly. The basic filler material usually has the consistency of a caulking compound. This material is made up of a polyester resin to which various fibers and other materials which affect the working properties have been added. The second material, usually called the hardener, is commonly a cream type preparation packaged in a squeeze type, plastic tube. Liquid hardeners have been used also, but they seem to be losing favor in comparison to the cream type materials.

It is common practice to use a pigmented cream hardener which causes the color of the plastic to change as it is mixed. This provides a color key to the proportion of hardener used in mixing up the material for application. The more hardener used, the stronger the color of the batch.

A container, usually a quart or a gallon, of plastic and a tube of hardener are usually sold as a unit. In most cases, the material in a tube of hardener is enough for a gallon of plastic. Two points should be kept in mind when mixing these materials for application. One is that the proportion should be kept reasonably accurate. The other is that they should be mixed thoroughly.

The proportion of hardener to plastic is stated in terms of reasonable accuracy because almost all of the available brands of material permit a reasonably wide variation without serious ill results. The more hardener used, the faster the material will harden. The opposite is also true; the less hardener used, the slower the material will harden. If too much hardener is used, the material will set up so rapidly it cannot be worked. If not enough is used, the material may never harden. The desired mixture is somewhere between these points. It is the best practice to always follow the manufacturer's recommendations.

Thorough mixing is of extreme importance because pockets of unmixed materials will not harden and may have to be dug out and replaced when the surface is finished.

TITLE: Abrasives

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Five different minerals are commonly used for manufacturing abrasives. Three of these are garnet, flint, and emery which are natural mineral abrasives. The other two are aluminum oxide and silicon carbide, which are manufactured at high temperatures in huge electric furnaces. Garnet, a semi-precious jewel, is by far the most important of the natural minerals. Emery and flint break down easily and are better suited for household use than for industry. Aluminum oxide is the more important of the two manufactured agents. It is the toughest, most durable abrasive available. The manufactured abrasives are best for use in the automotive field and, for that matter, in industry at large where the work is chiefly on metal.

The abrasive is put on a backing which is either of paper, cloth, or a combination of the two. For dry grinding or sanding, high-quality, hide glues are used for anchoring the abrasive grains to the backing. For wet sanding, resins are used as the binding agent.

Coated abrasives fall into two additional classifications based on how widely the minerals are spaced. If the minerals are close together, it is referred to as "close coat". If the minerals are widely spaced, it is referred to as "open coat".

In close-coated abrasives, the abrasive is applied in such quantity as to entirely cover the backing. In open-coat abrasives, the backing is from 50 to 70 percent covered. This leaves wider spaces between the abrasive grain. The opening coating provides increased pliability and good cutting speed under light pressures. Open-coated abrasives are used where the surface being ground is of such nature that closely spaced abrasive miners would rapidly fill up.

In the manufacture of coated abrasives, the abrasive minerals are applied to the backing either by the gravity method or by the use of an electrostatic field. The electrostatic field method is the more popular. In this method, a powerful electrostatic field compels the abrasive grains to follow its lines of force and become anchored in the glue with their long axes at right angles to the backing (standing on end). Since the lines of force are evenly spaced, the abrasive grains are evenly spaced. This upending of the abrasive crystals provides sharper, faster cutting power. Both close-coat and open-coat abrasives may be produced by either method.

Grit Sizes and Markings

The coarseness or fineness of abrasives particles is designated in three ways: by symbols, by mesh numbers, or by both.

SYMBOLS: 3/0, 2/0, 1/2, 1 1/2, 2, etc.

MESH NO: 400, 320, 280, 180, 100, 50, etc.

BOTH: 9/0-320, 5/0-180, 2/0-100, 1 1/2-40, 3-24, etc.

All products are identified by one of these numbering systems. Flint and emery are graded to different standards than any other abrasive.

TITLE: Grinding

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

While the body file cannot be completely replaced, many of the jobs that can be done with a file can be done just as well and much faster with a grinder.

Two basic types of grinders are in common use. These are the flexible shaft grinders and the hand grinder.

With each type, by means of attachments, a variation in the method of holding and driving the abrasive is possible. These attachments convert the basic grinder to a disc grinder, a drum sander, and a cone sander.



The technique of grinding with a disc grinder is considerably different from grinding with a drum or cone grinder. Refer to your Operation Sheets for the techniques.



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TITLE: Prevent Skin Irritation
COURSE: Automotive Body and Fender

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UNIT I: Metal Work

Creams are available to protect the skin from a condition known as occupational or contact dermatitis. This common type of dermatitis is not contagious. Improved resin formulas in the approved kits have almost eliminated skin irritation. Creams are supplied with the kit for men who have a tendency toward skin irritation from the resins or dust.

The application of these creams is recommended whenever the resin kit materials are used. Generally, the creams are not required when the plastic solder kit is being used.

Safety Precautions:

1. Use approved skin creams and repairing materials in making the necessary body repairs.
2. Be sure to use respirators and work in a well ventilated area.
3. Cleanliness is very important throughout the procedures in the repairing of fiberglass plastic bodies.

To Prevent Skin Irritation:

1. Wash hands clean. Dry thoroughly.
2. Squeeze about $\frac{1}{2}$ inch (or $\frac{1}{2}$ teaspoonful) of No. 71 cream into palm of hand.
3. Spread evenly and lightly until cream disappears. Work cream into cuticle, between fingers and around wrists.
4. Apply second coat, repeating steps No. 2 and No. 3.
5. Hold hands briefly under cold running water to set cream.
6. Apply the No. 55 cream over the No. 71 cream in the same manner as above. (Cream will wash off.) After sanding operations, hands may be rinsed under water to remove cream and dust. Do not rub hands together while rinsing.
7. Remove resin mixture from hands as soon as possible and imperatively before mixture starts to gel. This can be observed by the action of the material being used. Resin may be removed with lacquer thinner followed by washing in soap and water.

8. Respirators are recommended when grinding. Also some minor skin irritation from glass and powdered cured resin may be evident. Washing in cold water will help to minimize the irritation.
9. Use a belt sander with a vacuum attachment for dust control if possible.
10. Resin mixtures may produce toxic fumes and should be used in well ventilated areas.
11. Be careful not to get any resin material on clothing.
12. Use the right materials for the job. It is important to use the approved kits because rigid quality standards assure you the right material to do the job. Other materials available may not meet the required engineering and safety standards, both for strength and harmful skin irritations.
13. Keep the materials, utensils and work area clean and dry. The materials used in repairing fiberglass plastic bodies involve chemical reactions, and dirt or moisture may upset the chemical balances and produce unsatisfactory results.

TITLE: Fiberglass

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Fiberglass is composed of glass filaments or threads which have been spun into yarn. This glass yarn is then either woven into cloth or compressed into a loose mat. By saturating the cloth or the mat with a resin and allowing it to harden or cure, a solid panel is formed. In accidents, fiberglass panels have the great advantage of not transmitting impact to the rest of the vehicle, yet they are stronger than steel for an equal weight.

You'll be asked to make repairs to panels or molded sections which have been cracked, torn, broken, even splintered; but which are surprisingly easy to make whole again, once you gain the know-how.

How is Fiberglass Molded?

There are three general types or kinds of fiberglass molded parts:

1. Those produced by MATCHED METAL MOLDS. Chopped fiber and polyester resin is mixed, catalyzed and placed in a male and female metal mold, and heat and pressure applied. After a few minutes, the finished piece is removed--a fast, strength of the finished part may be found waiting.
2. The second method is known as SPRAY LAY-UP. Chopped-up fiberglass roving is blown into a single female mold, along with precatalyzed polyester resin, rolled in place by hand and allowed to cure. This method is obviously slower, the thickness of the finished piece more variable, and the end result largely dependent on the proper percentage of glass and resin, and the amount of pressure applied.

Reinforcing

Fiberglass mat and resin can be used to reinforce areas that are subject to excessive stress, or for tying in parts of fiberglass or wood, etc... Often mounting brackets will break away from a fiberglass reinforced piece and must be replaced. The easiest way to make this type of repair is to use "Canned Fiberglass." Canned fiberglass is in effect pure fiberglass, which hardens when spread over a damaged surface. Canned fiberglass is much easier to work than mat or resin. To reinforce an area, spread a coating of canned fiberglass over the weakened section.

To tie in a wood strut, mounting bracket, etc., apply canned fiberglass to the damaged surface. Push it down and press it into the canned fiberglass. More of this canned fiberglass should then be used to completely cover the connection, which ties it into the original structure. Canned fiberglass, in this instance, is easier to use than mat and resin.

In areas such as the nose section of large trucks, cracks often develop at the corners over the radiator. When this happens, the proper procedure is to grind the back side of the damaged panel 8 to 10 inches on either side of the crack. Saturate a piece of mat as outlined before, and roll this piece of mat over the crack. Sometimes it is wise to use a double layer of mat. You have now reinforced the area to prevent further cracking. But you still have a crack on the outside of the panel, and this must be repaired by bevel grinding and by filling in with canned fiberglass. A final coating of a special fiberglass filler is applied over the entire outer surface prior to painting.

TITLE: Safety Relating to Metal Work

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Hammers:

Always check to see that the hammer head is tight on the handle to prevent the head from flying off and injuring someone as the hammer is swung.

Dollies:

Always hold the dolly properly and avoid getting your fingers between the dolly and the metal being worked. Serious injury to your hand or fingers can result from the action of the hammer on the dolly.

Grinder:

1. Always wear safety goggles when grinding.
2. Never use a torn or broken grinding disc. A damaged disc will cause the machine to vibrate and a section of the disc could fly off and seriously injure someone standing nearby. The torn disc can also catch on the edge of the area being ground and twist the grinder from your hands.
3. Examine the electrical connections and make sure the cord and plug are in good condition and the machine is properly grounded.
4. When the grinder is not in use, place it on the floor, with the disc facing up.

Porto-Powers:

When using any device equipped with a hydraulic ram, remember that equal force is exerted on both directions from the cylinder. Make sure the anchor area is strong and secure enough to withstand the pressure needed to straighten the damaged area. It is safer to reinforce the anchor area with an angle iron to spread the force over a larger area.

TITLE: Types of Dollies
COURSE: Automotive Body and Fender

Page 1 of 2 pages
UNIT I: Metal Work

Alloys are deep forged, hardened and tempered. The working faces are highly polished.

Each dolly block can have only a few working faces, obviously not nearly enough to handle all the panels on an automobile. For this reason, several different dolly blocks are necessary to do efficient work.

Other factors which govern the size and shape of a dolly block are: Convenient and safe hand hold; balance for accurate control; enough mass or weight to be a good anvil; not too heavy to avoid fatigue; and adaptability for use on many different panels.

All of these factors govern the design of each dolly block. The blocks listed below furnish complete service for all panels, on all makes of cars.

Toe Dolly:

Its thinness and length make it accessible in narrow pockets. Its large flat face is frequently used in shrinking and dinging flat panels. Its flat sides furnish a convenient anvil for repairing flanges. These features give this dolly its continued popularity among metalmen.



Heel Dolly:

Its design permits one to reach into a sharp corner and a wide radius. Its continued high demand is based on these features, which no other dolly has.



450.

General Purpose Dolly:

This block has unlimited applications and is one of the most useful dolly blocks ever made. Its shape gives it a convenient and comfortable hand hold, even during the heaviest blows. Its weight, its balance and its several differently crowned working faces, together with its two beading and flanging lips, combine to give this dolly its wide range of uses.



*General Purpose
Dolly Block*



Bar Dolly Block



Wedge Dolly Block



Budd Dolly Block

TITLE: Types and Uses of Metal Hammers
and Slappers

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

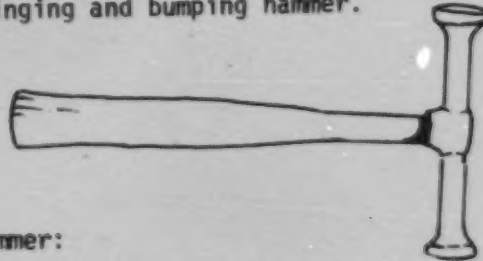
Probable the most frequently used tool in the body shop is some form of dinging hammer.

The face of the metal hammers may be round or square. The round-faced hammer is used for general dinging, while the square-faced is used for working close to a bead or other ornamentation. Also the face of the hammer may be flat or have a slight crown.

The overall length of the head of a dinging hammer may vary from 4 to 6 inches. The variation in "reach" is needed because working spaces vary considerably: Some fenders are crowned more than others; also the space available for swinging the hammer varies.

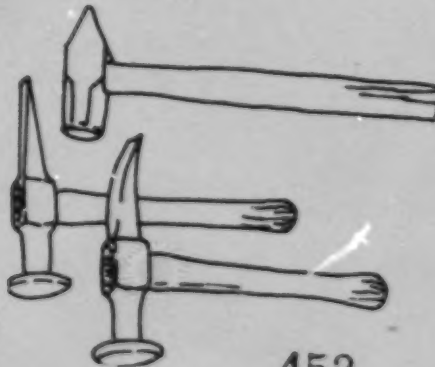
General Purpose Dinging Hammer:

Used on fenders and other high-crown panels. The large, low-crowned face is used for dinging, "on the dolly." The small, high-crowned face for dinging, "off the dolly" and for driving down ridges. This is the general purpose dinging and bumping hammer.



High Crown Cross Pein Hammer:

A well designed and balanced hammer with high crown working faces for concave surfaces works well on doors, rear quarter panels, fenders and hoods.

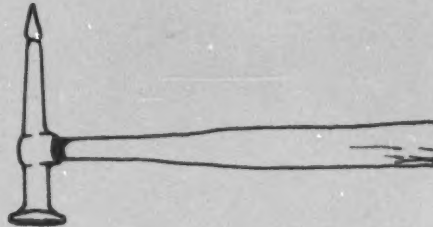


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Pick Hammer 6":

Has a long-reach, thin point for dinging up low spots when metal finishing low crown panels. With this hammer, you can reach over braces and the inner construction inside bodies to the hard-to-get-at places. The dinging head has a high-crown face and is perfectly balanced with the pick end.

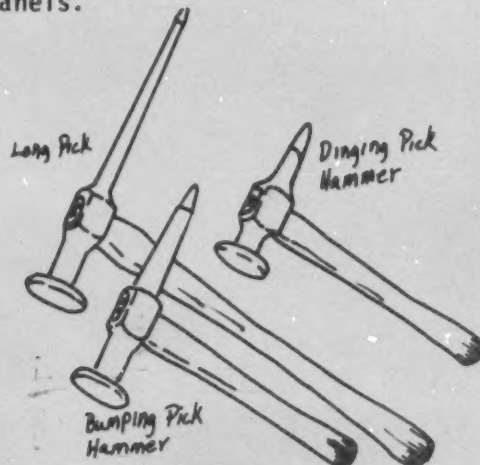


General Purpose Pick Hammer 4":

The pick hammer has a medium size point and medium reach for general work. The strawberry point gives weight to perfectly balance the low-crown dinging head. The working face has a low-crown.

Utility Pick Hammer 2":

It has a blunt point and a short reach. This is one of the handiest little pick hammers ever made for driving up low spots in high-crown panels. Use this hammer on fenders without removing the wheel, or use it for other repairs where there is little clearance. Another good use is for thin-gage panels.



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Slappers:

This tool is used as a substitute for a body hammer. It may also be called a bumping file. It is used on the exterior of the metal, and covers a larger area than a bumping hammer. You use it with a slapping motion backed up by a dolly block.

Its primary use is in metal finishing.

TITLE: Identification of Spoons, Caulking
and Bending Irons

Page 1 of 2 pages

COURSE: Automotive Body and Fender

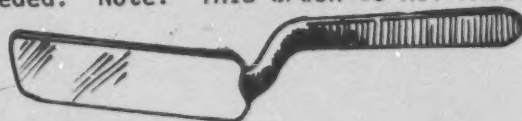
UNIT I: Metal Work

Body spoons are multi-purpose tools used as pry bars to pry the metal back into position, and are also used as dolly blocks when the area to be straightened cannot be reached with a conventional dolly block. For example, dents in doors or deck lids can often be backed up with a spoon inserted through openings in the reinforcing on the back side of the door. Spoons are also used to distribute the hammer blows over wider areas.

Light Dinging Spoon:

With this spoon, ridges can be easily dinged down level and very smooth. In fact, many ridges can be dinged so smooth that filing and disc sanding are unnecessary. When held against the ridge and struck with a hammer, it spreads the hammer blow over a large area of the ridge, making it smooth and prevents nicking or marking of the metal.

Being balanced, the dinging spoon should be held somewhat loosely in the hand, so it can locate itself on the high spot or ridge. The hand is used to guide the spoon, yet allowing it to float. In this way, the spoon levels itself on the ridge and distributes the hammer blow to the exact spot where needed. Note: THIS SPOON IS NOT MADE FOR PRYING.



Long Turret Top Spoon:

Light Dinging spoon

This is a general purpose body spoon. The extra long handle gives it balance in the dinging operation, when used as a dolly behind reinforcements. The end of the blade has a caulking face. The rugged structure of the spoon permits heavy blows with the hammers. Its design makes it an excellent pry tool.



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Long turret Top Spoon

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The Combination Spoon:

This is a general purpose fender spoon. It is used as a dolly behind brackets, inner panels, and similar places. The handle is offset to give balance in the dinging operation. It has a high-crown working face and a long reach, giving it wide adaptability.



combination spoon

TITLE: Molecular Structure of Metals

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

Metallurgical Structure:

The smallest single unit having the same properties as the mass is called a molecule in some instances and an atom in others.

Why the difference? Let's take water as an example. It takes two parts of hydrogen and one part of oxygen to make the smallest single unit of water. The two units of hydrogen are two atoms combining with the one atom of oxygen.

Iron is not a compounded substance but a basic element. Therefore, the individual complete unit is called an atom. Metallurgists refer to metals in terms of atoms or metallurgical structure while chemists refer to molecular structure when referring to the basic components.

Metals, unlike other matter, are crystalline solids. This means that metals are made up of minute particles which are arranged in structure much as a diamond. This might be best understood in the following quotation: "In crystalline solids...the atoms are packed into space in a very orderly way. Large numbers, hundreds and hundreds of millions of atoms, find themselves arranged on a lattice, which is built up of small symmetrical cells, as a brick wall is built up from bricks... The wall of atoms has different designs on its face. This is due to different inclinations which neighboring lattices possess. Each block, containing millions of atoms on an unbroken continuous lattice, is known as crystalline material, or sometimes, simply a grain."

For our study we shall refer to the atom structure as "metallurgical structure."

TITLE: Basic Steps in Metal Repair

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

There are two procedures which can be followed in repairing any damaged panel. One procedure is to straighten only those portions of the damage which have taken a permanent set. The relatively undamaged areas will then spring back approximately to its original shape.

The other procedure is to get inside the damaged area with a heavy hammer, or other tool, and beat or push the whole area out roughly to shape. This is the "rough-'em-out--smooth-'em-up" method. Now, it is possible to obtain repairs of fairly good appearance by the latter method, but with a difference.

Observe that if we repair a bent panel by forcing it out roughly to shape, we invariably add unnecessary roughness to the damage because those areas of metal which are only flexed must be forced back into position by hammer blows or by other means. This results in humps, knots, wavy and rough areas (frequently stretching the metal) where very little damage existed before.

In other words, the "Rough-'em-out--smooth-'em-up" method always causes additional damage to the panel in the flexed areas. This inevitably results in an excessive amount of work and time being spent on the job.

On the other hand, the first method aims at repairing only those portions of the damage which have taken a set and actually require repairs.

In minor damages, requiring only ten or fifteen minutes repair work, the saving of time necessarily is small; however, the work is always easier to perform. On large jobs the work is not only easier, but the difference in the efficiency of the two methods amounts to many hours.

TITLE: Repair Methods

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

The repair method has three phases--analysis, metal bumping, and metal finishing.

Analysis is the first and most important phase, because by it the mechanical operations of bumping and finishing are planned so that they are simplified and shortened. To an experienced metalman, analysis is a brief operation. He notes the location of direct damage, the direction from which the damaging force came and the extent of the indirect damage.

He also determines whether and how much the reinforcing members of the body or fender are bent, and most important, the probable sequence in which the ridges and V-channels were formed as the damage occurred.

Metal Bumping is the mechanical phase in which the repairman restores the damaged panel, or panels, approximately to their original shape. On the basis of his analysis he begins at the farthest extremity of the damage; that is, he removes the ridges and V-channels one by one in the reverse order in which they were formed. He works on each one as long as it goes back to its original position easily. During this operation, he may use one, or two, or even three, body jacks against the reinforcements, or body superstructure, always moving the damage back through the successive stages in which it was formed. Welding, shrinking, and torch soldering are a part of this phase of body and fender repair.

The third phase, metal finishing, is the process of preparing the metal-bumped surface for fine, smooth appearance, ready for repainting. The metal-bumped areas are filed, disc ground, and sanded smooth. Minor imperfections are smoothed by raising or lowering to exact level. Minute imperfections are filed or sanded to a precision job. When this phase is complete, the outside surface of the panel is as smooth as when new and is ready to be repainted.

TITLE: Metal Bumping

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

The hammer and dolly are the basic tools and their use is the basic operation around which the body and fender repair trade has developed.

There are two distinct and separate uses of the dolly in relation to the hammer. The dolly may be held directly under the spot struck by the hammer face, or it may be held to one side. These procedures should be classified as hammer on-dolly and hammer off-dolly.

Hammer On-Dolly:

The first step in learning to use the hammer on-dolly is to develop the skill necessary to place the dolly under the metal and strike a hammer blow directly on it. This often seems to be an impossible task to the beginner, but it is actually an easy one to master. Of course practice is important, and it is easier for some than for others, because it is essentially a matter of coordination between the hand and the eye. Even though the hand holding the dolly is out of sight under the panel, the student soon learns to bring any spot on the face of the dolly into contact with the spot he strikes. With practice, this can be done as easily as though the surface were transparent.

Light to medium hammer blows should be used when practicing to hit the dolly. The grip and swing of the hand and arm in striking the blow are important. Frequently, the beginner has learned to use a hammer to drive nails and on such tools as chisels and punches. If this is true, he has an unlearning process to go through before he can expect to use the hammer on-dolly as it should be.

Hammer Off-Dolly:

The first step in learning the hammer off-dolly operation is to develop the skill necessary to place the dolly in the right spot when the hammer blow strikes. This spot will be close to but away from the spot on which the hammer blow falls. The skill needed to find this spot is similar to that required to locate the spot under the hammer for on-dolly use. After the beginner has mastered the problem of placing the dolly under the hammer, it is relatively easy for him to learn to place it away from the hammer.

The next step is learning to judge exactly where the dolly would be placed to accomplish the desired result. This is a matter of locating high and low spots visually and moving the dolly under the proper one for each hammer blow. This is a continuing situation, because the spot must be chosen each time a hammer blow is struck.

The action of the hammer off-dolly differs from the action on-dolly in the first contact. Since it is not being supported by the dolly, the spot struck by the hammer is driven down.

TITLE: Metal Reactions to Heat
COURSE: Automotive Body and Fender

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UNIT I: Metal Work

Heat Distortion:

Heat distortion may be defined as the resultant surface irregularities in sheet metal due to the application of heat. The actual distortions or irregularities are caused by the uneven affects of expansion and contraction.

Heating causes expansion and cooling causes contraction. The greater the uneven affect between expansion and contraction, the greater the distortion.

The amount of distortion in a given sheet metal panel is related to the following factors:

- a. Temperature - The greater the temperature, the greater the distortion is apt to be.
- b. Size of heated spot - If high temperatures are used, the heated spot will be larger and the distortion will be greater.
- c. Shape of area surrounding heated spot - The shape of the surrounding area is important because differently shaped contours react differently to expansion and contraction.
- d. Rate of cooling - This is a highly important factor. The faster the rate of cooling, the greater the distortion is likely to be.

NOTE: A spot that is not heated enough to cause discoloration will have very little if any distortion. Distortion will be at a minimum.

When an area is heated to a temperature that causes the spot to become black, some distortion may be caused, depending upon the shape and condition of the metal. A heat of cherry red temperature will cause a very noticeable distortion.

When the movement of the heated area is restricted by surrounding cooler metal, the lineal expansion causes bending or bulging of the heated area, because the expansion force is increasing and the resistance to bending is decreasing. The lineal expansion and contraction are directly related to the temperature rise and drop. The higher the temperature, the greater the bending will be.

TITLE: Use and Care of Slide Hammer
and Pullrods

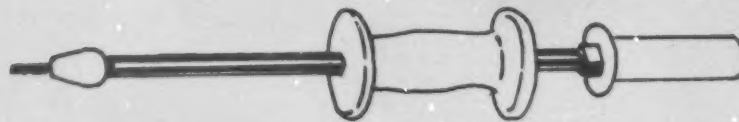
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COURSE: Automotive Body and Fender

UNIT I: Metal Work

When removing dents and creases from auto body panels, considerable time is often required to remove the interior trim. Also the work is complicated when the damage is located in certain areas such as doors and rear deck lids, because of metal braces and other structural members which make it difficult to use the conventional dolly and hammer method.

On many jobs, the use of a slide hammer or pullrods makes it unnecessary to remove upholstery or interior trim, as the work is done from the outside of the damaged panel. The procedure is to drill a series of 9/64 inch or 1/8 inch holes in the deepest part of the areas. The crease is then worked up gradually by inserting the hooked ends of the pullrods in the holes and pulling on the handles. Depending on the type of damage, a slide hammer will be used to rough out and shape the section. The slide hammer is used with more force and for deeper creases.



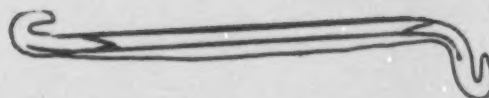
Slide Hammer

TITLE: Use and Care of Flanging and
Beading Tools

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work



There are so many special-purpose tools used for straightening sheet metal that it would be impossible to list them all. The two tools shown are typical flanging and beading tools.

The tool shown is a special purpose flanging tool for straightening flanges. It is particularly suited to straightening the bead section of fenders, but it may be used on any flange which is turned away from the operator's side. In use, one end is hooked into the flange to be straightened, and other end is held by the operator as he strikes hammer blows on the bar, close to the panel.

The flange bender tool is for bending narrow flanges. In use, the slot formed by the bend in the end is slipped over the edge of the flange, and the tool either is turned or twisted to make the desired bend.

TITLE: Identification and Use of
Suction Cups

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Suction cups assist in removal of dents in doors, roofs, cowls, and fenders. They are also very useful for installing glass, as they provide a "handle" with which to grip the glass as it is being set in place.

The suction cup works on the simple principle of atmospheric pressure, which is about 14.7 pounds per square inch at sea level. The suction cup is placed on the work and the center of the cup is pushed down, forcing the air out of the area between the cup and the work. With this area now a vacuum, atmospheric pressure holds the cup to the work with pressure on the outside of the cup. The edges of the cup form a seal to prevent air from re-entering the area between the cup and the work.

Suction cups should be stored in a clean, dry, cool place. They must never be used on hot metal or around any open flame, as they will melt and distort.



TITLE: Porta-Powers

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COURSE: Automotive Body and Fender

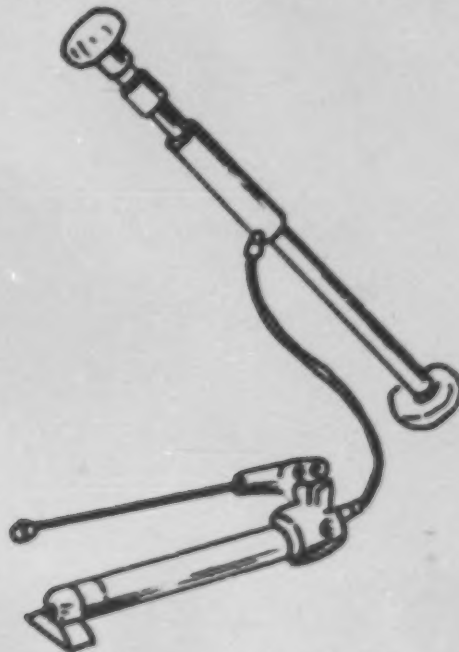
UNIT I: Metal Work

The important feature of any porta-power is that it is fitted with screw-threaded ends to which extension tubes can be attached. Such threads also permit the attachment of special fittings or ends which have been designed to apply force to various sections of the automobile sheet metal with the least amount of damage.

Most of the porta-powers available for use on sheet metal are hydraulically operated although a few of the friction type are quite popular. The hydraulic type is available in two basic sizes: light duty, usually equipped to be used with 3/4 inch inside diameter extension tubes; and heavy duty, usually equipped to be used with 1 1/4 inch inside diameter tubes.

The capacity of jacks made by different manufacturers varies. Most light-duty jacks are rated from 3 to 4 tons, and most heavy-duty jacks are rated from 7 to 10 tons. However, for working sheet metal, the selection of the jack is determined mostly by the rigidity required of the tubes rather than the capacity. Where the jack must be used with offset loads, there is a tendency for the jack and tubes to bend; therefore the jack and tubes must be rigid enough to withstand this. Because of this, the heavy-duty jack often must be used, even though the load is well within the capacity of the lighter one.

The body jack is also an important tool in straightening frames. Such work is practically limited to the heavy-duty jack.



Porta Power
585 466

TITLE: Metal Cutters

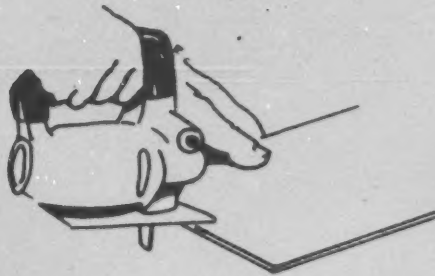
Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Power Jigsaw:

There are several different types of equipment that are broadly classed as saws. One saw that is used for cutting sheet metal in the body shop is the jigsaw. This electrically driven tool will cut an arc of small radius and is also used for straight line cutting.



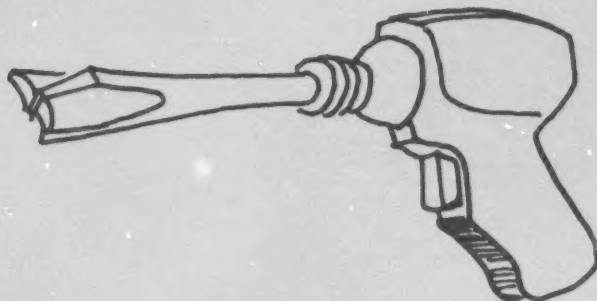
Shears:

While power driven equipment is used for all major cutting of sheet metal in auto body shops, hand shears are still used extensively for small work and close fittings of panels.



Impact Hammer:

An impact hammer, fitted with a cutting chisel is also used for cutting sheet metal. However, this frequently results in a rough ragged cut. As a result other methods are usually preferred.



Electric Shears:

The cutting away of damaged panels to enable new body sections to be fitted can be accomplished with the use of an electric shear. Some straightening of the panel in front of the shears may be required as the operation proceeds to enable the cutters to overcome sharp changes in contour, arising from the impact.



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TITLE: Taps, Dies, and Screw Extractors

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

Tap and Die Set:

Tap and dies are devices used for cutting inside and outside threads.

Taps are made in several styles. The taper tap is used to thread a hole completely through a piece of metal, the plug tap to thread a hole only part way, and the bottoming tap to thread a hole to the bottom when the hole does not go all the way through the metal.

The tap is held in a tap wrench. The wrench jaws are adjustable and can be tightened to hold the tap securely.

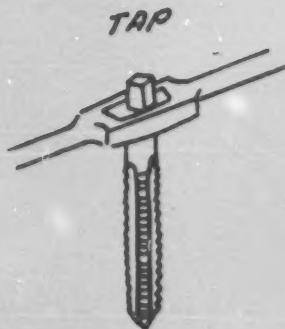
Dies are cut outside threads. Dies are held in diestock during the cutting operation. The procedure is similar to that required for tapping. The rod should be chamfered on the end so that the die will start easily.

Screw Extractors:

Screw extractors are used for removing screws and studs which have broken off and cannot be turned by conventional or vise-grip pliers. The screw extractor is made with a tapere

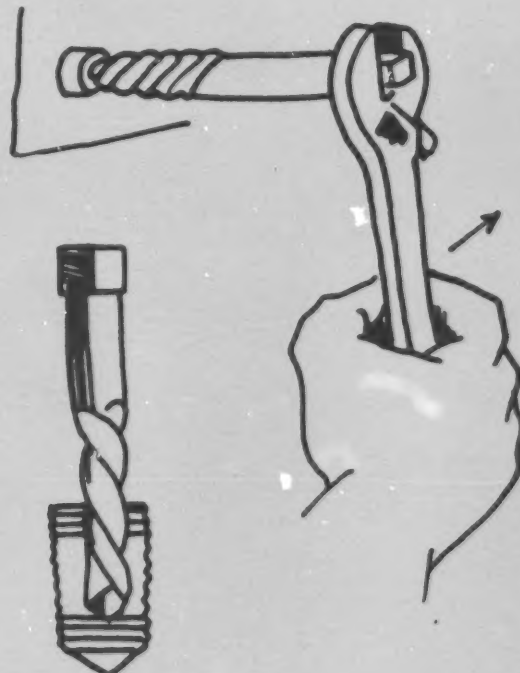


DIE



TAP

SCREW EXTRACTOR



TITLE: Body Files

Page 1 of 1 page

COURSE: Automotive Body and Fender

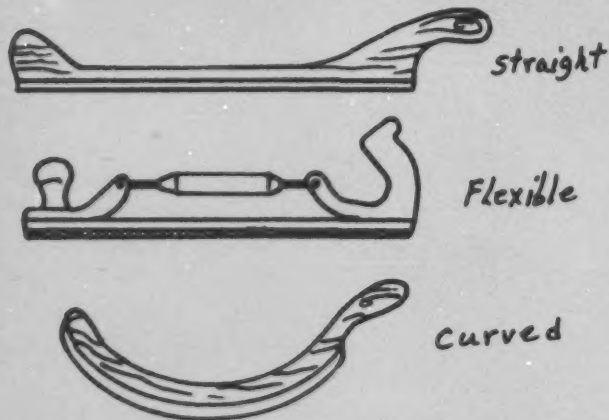
UNIT I: Metal Work

Body files are available in straight and curved forms of various sizes. After bumping and dinging have been completed, the body file is used to produce a scratch pattern on the metal which shows the high and low spots. The file is also used to shape areas that have been filled with solder or plastic to the proper contour.

Body files are about 14 inches in length, with cutting teeth on both sides. The teeth are formed in a curved fashion, and there are three standards for tooth spacing - 6 1/2, 8 and 9 teeth per inch. The shape of the teeth allows the material to escape without clogging the teeth.

Files are placed in holders when in use. These holders are available in straight, flexible and curved forms. The file is installed in the holder so that the cutting teeth face forward, making the forward stroke the cutting stroke. The file is attached to the holder by loosening the turnbuckle screw on the holder and placing the file on the holder, then tightening the screw finger tight.

Handles on some holders can be offset either to the right or the left, depending on the job to be done.



TITLE: Estimating

Page 1 of 4 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Establishing a price for which certain damage on an automobile can be repaired is known as estimating. To be skillful at this phase of Automotive Body and Fender one must consider the following:

- . A sequence of inspection
- . Flat rate limitation
- . Material costs
- . Equipment needed
- . Sub-contracts
- . Parts prices--new and used
- . Determination if new or used parts will be used
- . Overlap of time or included time

On a basis of these considerations, a price is established which serves as a contract between the shop owner and the automobile owner. Accuracy is of utmost importance if the shop owner is to make a profit. Continual over pricing will result in a loss of business due to another shop's ability to under bid you. Bids that are constantly too low will result in a financial loss to the shop owner due to a loss on each job. Accuracy in this phase is extremely important, in addition to a thorough knowledge and ability in all phases of automotive body and fender repair.

To overcome the problem of missing or overlooking damaged parts and certain labor functions, learn to use a sequence of inspection sheets.

SEQUENCE OF INSPECTION

I. CHASSIS GROUP

FRONT BUMPER Face Bar, Guards, Back Bars, Gravel Deflector.
FRAME --

Conventional Side Rails, Cross Members.
Unitized Underbody.

CHASSIS SHEET METAL

HOOD Hinges, Locks, Moldings, Ornaments.
FRONT FENDERS Inner Skirts, Wheelhouse, Supports, Ducts,
Moldings, Headlights, Parking Lights.
RUNNING BOARDS Board, Hangers
REAR FENDERS

COOLING

APPEARANCE PARTS Grille Panels, Grilles, Moldings, Ornaments.
SUPPORTS YOKE Brackets, Baffles, Splash Apron.
COOLANT COMPONENTS .. Fluid, Radiator, Assembly Hose, Thermostat.

FAN Shroud, Blades, Hub, Belt.
WATER PUMP Housing, Shaft, Rotor.
OIL Lubricant, Filler Pipe, Crankcase Ventilator.

FRONT SUSPENSION

TIRES & WHEELS Front Tires, Tubes, Wheels, Hub Caps, Moldings.

BRAKES FRONT
(Conventional , Drums, Hubs, Dust Caps, Bearings, Cups, Cones,
Power) Grease Retainers, Backing Plates, Shoes, Wheel
Cylinders, Hose, Lines, Master Cylinder, Pedal,
Linkage.

SUSPENSION --

1. King Pin Knuckles, King Pins, Knuckle Support, Pivot Pins,
Cross Shafts, Upper and Lower Control Arms, Shock
Absorbers, Springs, Stabilizer.

2. Ball Joint ...

3. Torsion Bar ..

4. Air

5. Conventional . Knuckles, King Pins, Front Axle, Springs, Leaves,
Clips, Shackles, U Bolts.

STEERING (Conventional, Power)

LINKAGE Knuckle Arms, Tie Rod Ends, Tie Rods, Idler, Drag
Link, Pitman Arm.

GEAR ASSEMBLY Wheel, Column Housing, Bracket, Gear Housing and
Cover, Main Shaft and Gear, Pitman Shaft.

II. POWER GROUP

ENGINE

FRONT END Harmonic Balancer, Timing Cover, Camshaft and
Crankshaft Gears, Timing Chain, Engine Front End
Plate.

EXTERNAL POINTS Engine Mountings, Rocker Arm Cover, Cylinder
Head, Valve or Push Rod Cover, Cylinder Block,
Oil Pan, Oil Pump, Oil Filter.

POWER POINTS Pistons, Rings, Pins, Connecting Rods, Crank-
shaft, Bearings.

VALVE POINTS Camshaft, Valve Lifters, Push Rods, Rocker
Assembly, Valves, Springs, Guides.

ELECTRICAL

IGNITION Generator, Voltage and Current Controls, Battery,
Positive and Negative Cables, Starter, Coil, Dis-
tributor, Spark Plugs, Wiring, Switches, Relays.

FUEL AND EXHAUST

FUEL Cap, Filler Neck, Tank, Tank Gage Straps, Line,
Flex Line, Fuel Pump, Filter, Pump Line, Carbu-
retor, Air Cleaner, Intake Manifold.
EXHAUST Manifold, Pipe, Muffler, Tail Pipe, Mounting
Brackets.

CLUTCH

LINKAGE POINTS Pedal and Linkage to Fork.
EXTERNAL POINTS Clutch Housing, Flywheel Underpan.
MOVING POINTS Pilot Bearing, Flywheel, Clutch Disc, Pressure
Plate Assembly, Throw-out Fork, Bearing.
HYDRAULIC COUPLING .. Impeller, Turbine, Stator.

TRANSMISSION

LINKAGE Hand Lever to Transmission Assembly.
EXTERNAL POINTS
(Conventional) Case, Cover.
INTERNAL POINTS Main Drive Gear, Counter Shaft and Gears.
(Conventional) Main Shaft, Reverse Idler
EXTERNAL POINTS
(Automatic) Case, Oil Pan.
INTERNAL POINTS Planetary Gears, Servos, Bands, Clutches.
(Automatic) Pump.
UNIV. JOINTS Front, Intermediate, Rear and Coupling.

REAR SUSPENSION

TIRES & WHEELS Rear Tires, Tubes, Wheels, Hub Caps, Moldings.
BRAKES REAR Drums, Backing Plates, Shoes, Wheel Cylinders,
Lines, Hose, Parking Brakes.
SUSPENSION Rear Axle Housing, Differential Carrier, Pro-
peller Shaft Housing, Support and Radius Arms,
Springs, Leaves, Clips, Shackles, U Bolts, Shock
Absorbers, Sway Bar.
MOVING PARTS Axle Shafts and Bearings, Differential Ring and
Pinion Gears, Spider Gears, Propeller Shaft.

III. BODY GROUP

BODY SHELL

TOP Roof Panels, Rails, Drip, Bows, Back Window Inner
Panel, Windshield Header Panel, Moldings, Wind-
shield Glass, Garnish, Reveal and Rubber Moldings,
Wipers, Rear View Mirror, Back Window Glass, Garnish,
Reveal and Rubber Moldings.
FRONT Windshield Pillars, Cowl Upper and Side Panels,
Hinge Pillar, Firewall or Dash Panel, Ventilator,
Chrome Moldings.

SIDES Center Pillar, Quarter Panel, Quarter Panel Ext.
Lock Pillar, Wheelhouse, Chrome Moldings, Tail
Lights, Backup Lights, Wheel Shield, Quarter Glass,
Garnish Moldings, Run and Sash Channels, Regulator,
Handle.
BACK Rear Upper Panel, Parcel Shelf, Rear Lower Panel.
FLOOR Rocker Panel, Moldings, Sill Plates, Floor Pan,
Rear Compartment Floor Plan, Rear Bumper.

DOORS

DOOR Hinges, Door Check, Latch, Lock Cylinder, Striker
Plate, Outside and Inside Handles, Chrome Moldings,
Seal.
GLASS Window Glass, Garnish Moldings, Sash, Run and
Division Channels, Regulator, Handles, Vent Glass,
Chrome and Rubber Channels, Regulator, Handle.

REAR LID

REAR LID Hinges, Lock, Handle, Chrome Moldings, Ornaments,
Seal.

TRIM

TOP Headlining, Listing Rods, Sun Visors.
FRONT Cowl Side Trim, Dash Mat.
SIDES Center Pillar Trim, Door Weather Cord, Rear Quarter
Trim, Rear Compartment Side Trim.
DOORS Trim Padding, Arm Rest.
BACK Parcel Shelf Trim.
FLOOR Floor Mats and Carpet.
SEATS Frame, Tracks, Cushion Cover, Cushion Back Cover,
Springs, Lower Trim.

INSTRUMENTS

INSTRUMENTS Iron Instruments, Instrument Panel, Glove Box,
Door, Lock, Accessories.

TITLE: Safe Use of Tools

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Files should never be used without protective handles, as there is always the danger of injury from the tang. Nor should files be used as pry bars, or hammers. Files are made with hard temper and consequently are quite brittle. When hammered small pieces may fly off from the file and cause severe wounds or loss of eyesight. Hardened surfaces, such as the face of an anvil, should not be struck with a hammer as bits of steel may fly off and cause damage. Hammer and sledge care must always be exercised so that the head is always securely attached to the handle. Loose hammer and sledge heads may fly off when the tool is used and anyone standing in the way can be struck and severely injured.

When the head of a chisel becomes swagged over, it should be discarded or reground to remove the swagged edges. This will prevent bits of steel from flying off and causing damage.

Whenever grinding is done, the body man should wear goggles to protect his eyes. The grinding wheel should always be provided with a protective guard. The reason for the guard is that in the event of the grinding wheel flying apart due to centrifugal force, the danger to the operator will be minimized. Unless the grinding wheel is designed to take such strains, its side surfaces should not be used for grinding.

When using a wrench, there is always danger to the body man if he pulls on the handle, rather than pushes on it. Should the wrench slip when pushing on it there would be less danger of skinning the knuckles. In fact, when the jaws of a wrench become worn or are sprung, the wrench should be discarded, as it will no longer fit the nut securely and will tend to slip.

Compressed air is an important "tool" in every shop. The air gun should never be pointed at anyone. The high pressure of the air can blow dust and dirt particles at such high speed that they can puncture the skin and get into the eyes.

TITLE: Types, Uses and Care of
Screwdrivers

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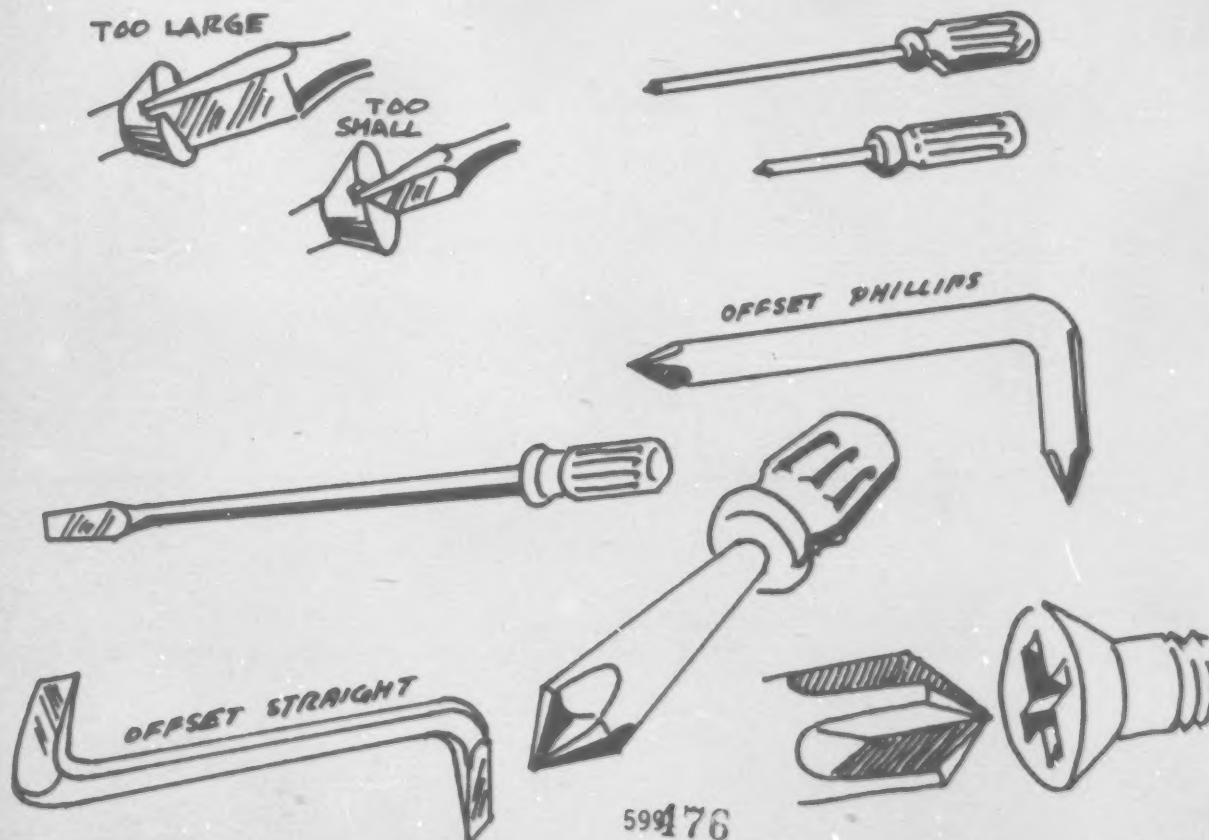
COURSE: Automotive Body and Fender

UNIT I: Metal Work

The screwdriver is used to drive, or turn, slotted screws. Do not use a screwdriver as a pry bar or as a punch or chisel; you are likely to break it. Keep the tip properly ground, with the sides practically parallel at the end. If the sides are tapered, the tip will tend to rise up out of the screw slot when it is turned. Always select the proper screwdriver for the job; the tip should fit snugly in the screw slot. A screwdriver that is too large or small is hard to use and may damage the screw or part being worked on.

The Phillips-head screw has two slots that cross at the center. It is widely used on automobile trim and molding; there is less chance that the screwdriver will slip out of the slots and damage the finish. Three sizes of Phillips-head screwdrivers, 4, 6, and 8 inch, handle most automotive work.

Offset screwdrivers are handy for removing screws in hard-to-get-at places. The two blades are at right angles; the ends can be reversed as a screw is tightened or loosened.



TITLE: Safe Operation of the Grinder

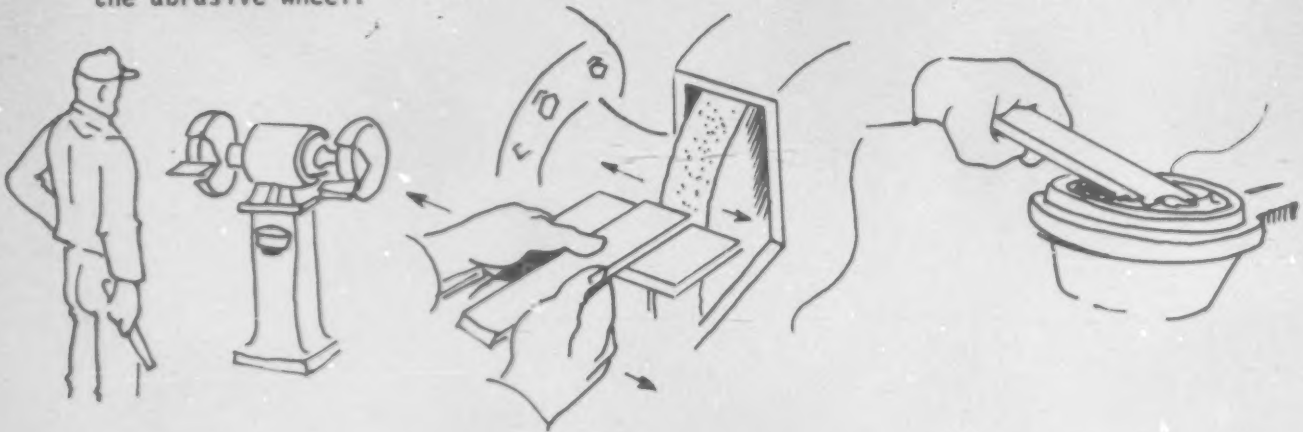
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COURSE: Automotive Body and Fender

UNIT I: Metal Work

The grinder is a metal working tool. Through the use of the abrasive wheel, the skillful operator can safely cut away unwanted areas of metal stock. Some of the operations that can be performed on the grinder are sharpening, thinning, narrowing, shortening, smoothing, and fitting various metal pieces.

The fingers and hands are the body parts most often injured by the improper use of the grinder. The head, chest and arms can also be injured. Injuries to the eyes can occur from flying particles of hot metal which are removed from the stock by the abrasive wheel. Injuries may range from complete loss of sight due to particles entering uncovered eyes, to minor burns. Improper adjustment of the tool rest can cause the stock metal to be thrown by the abrasive wheel. This flying piece of metal can cause bodily injury upon impact. The fingers and hands can be injured by actual contact with the abrasive wheel.



TITLE: Types, Uses and Care of Wrenches

Page 1 of 2 pages

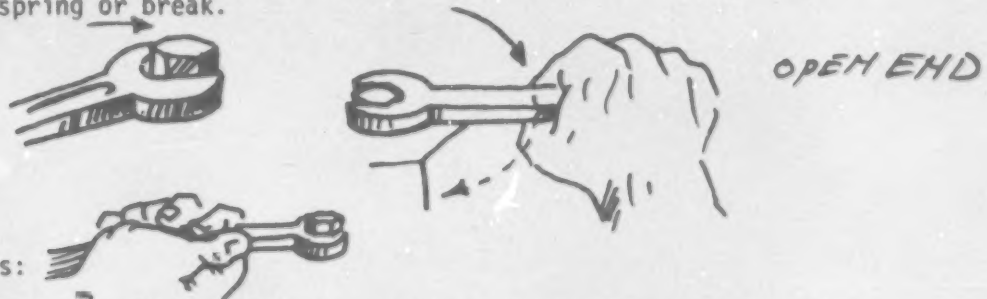
COURSE: Automotive Body and Fender

UNIT I: Metal Work

Wrenches of many types are available, including open-end, box, combination open-end and box. Each has its special use.

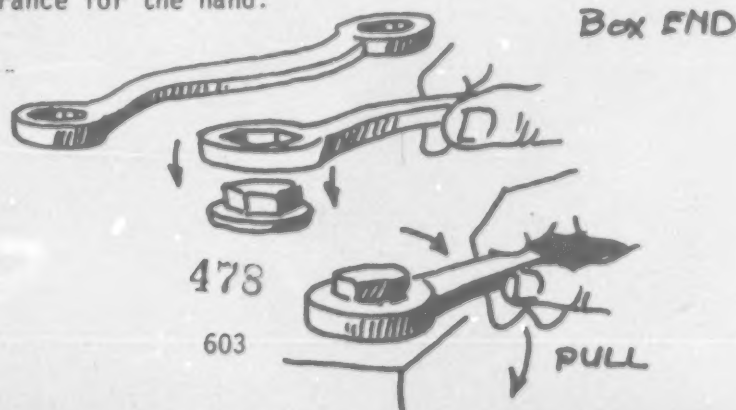
Open-End Wrenches:

Open-end wrenches are designed to tighten or loosen nuts or bolts. The opening is usually at an angle to the body to permit turning a nut or bolt in a restricted space. After the nut or bolt is turned as far as the restricted space will allow, the wrench can be turned over 180 degrees to permit further turning of the nut or bolt. By turning the wrench over after each swing, the nut or bolt can be loosened or tightened satisfactorily. Pull on the wrench rather than push. If it is necessary to push, push with the palm of the hand and keep the fingers out of the way so that, if the nut or bolt suddenly gives, the knuckles will not be hurt. Make sure that the wrench fits the nut or bolt head snugly. If it fits loosely, excessive strain is thrown on the wrench and it may spring or break.



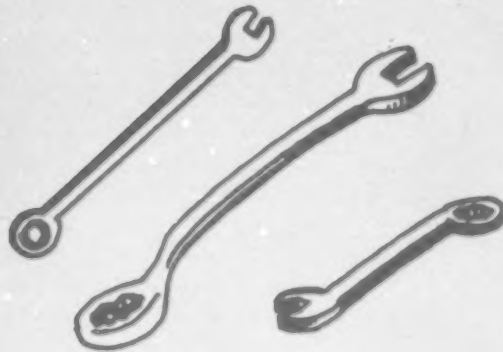
Box Wrenches:

Box wrenches serve the same purpose as open-end wrenches. The opening into which the nut or bolt head fits is completely surrounded, or boxed, by the box wrench. Box wrenches can be used in very restricted spaces because of the thinness of the metal in the wrench head. The wrench cannot slip off the nut. The 12-point box wrench, not universally used, has 12 notches in the head, so that a nut or bolt can be installed or removed even where there is a swing of only 15 degrees. Some box wrenches have the heads at an angle of 15 degrees to the handle to provide added clearance for the hand.



Combination Open-End and Box Wrenches:

These have a box wrench on one end and an open-end wrench on the other. The box wrench is more convenient than an open-end wrench for final tightening or breaking loose of a nut or a bolt but is less convenient for otherwise turning the nut or the bolt. The box must be lifted completely off the nut and then placed back on for each swing. On the other hand, the open-end wrench is less convenient for final tightening or breaking loose of a nut or a bolt, since it is more likely to slip off; but it is more convenient for running a nut or a bolt off or on. Thus the combination open-end and box wrench enables the mechanic to use one type and then the other by merely reversing the ends.



combination

TITLE: Ratchet and Socket Use and Care

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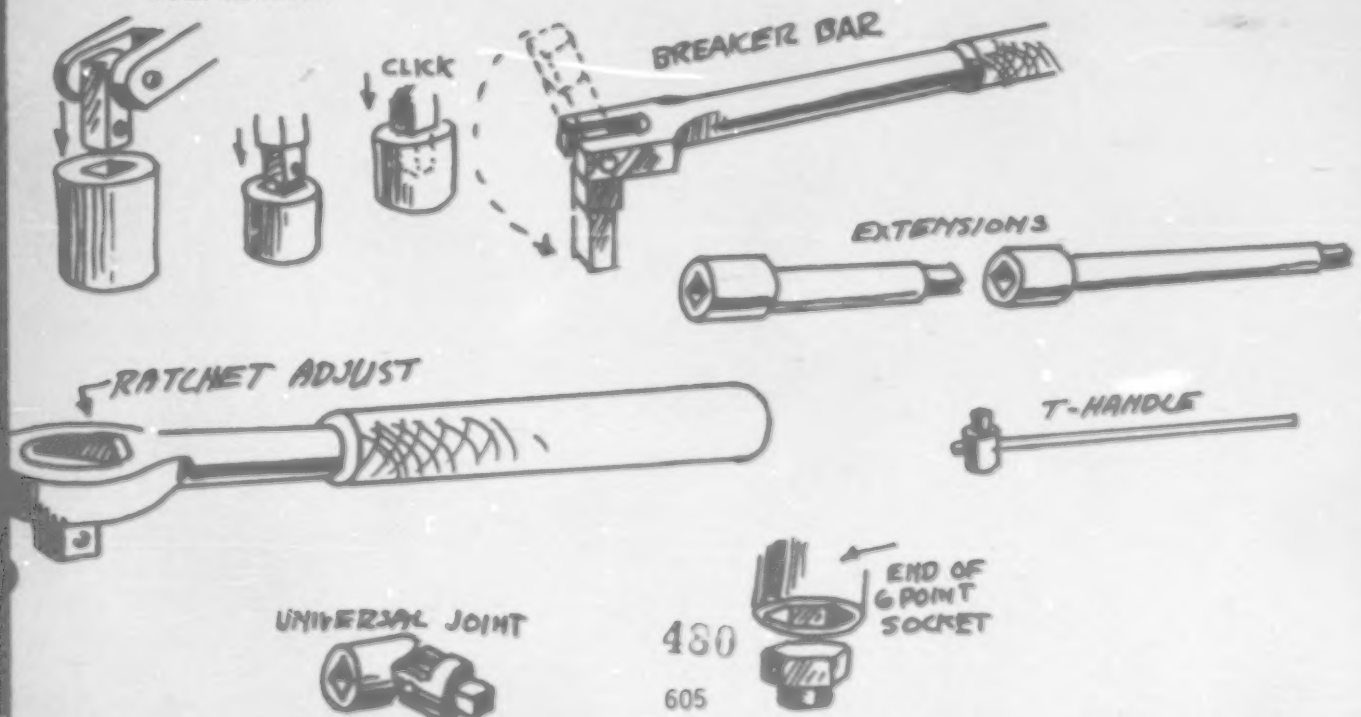
COURSE: Automotive Body and Fender

UNIT I: Metal Work

Socket wrenches, like the box wrench, completely surrounds the nut to be tightened or loosened, and in that way there is little chance of the wrench slipping from the nut. With assorted handles they greatly reduce the time for removing nuts. Usually the socket wrench used in automotive work has 12 grooves to engage the corners of the nut. Socket wrenches come in sizes from approximately $\frac{3}{16}$ in. to $1 \frac{5}{8}$ in. Socket wrenches as used in automotive service work have detachable handles of various types. The drive opening of the socket, is the opening in the socket in which the wrench handle is placed is $\frac{1}{4}$ in., $\frac{3}{8}$ in., $\frac{1}{2}$ in., or $\frac{3}{4}$ in. square. This is known as the "drive". In addition, one manufacturer has a socket wrench with $\frac{7}{16}$ in. drive, which is designed to take the place of both the $\frac{3}{8}$ in. and $\frac{1}{2}$ in. drive socket sets.

Bodymen usually have a set of $\frac{1}{4}$ in., $\frac{3}{8}$ in., and $\frac{1}{2}$ in. drive socket wrenches in their kits. The $\frac{1}{4}$ in. square drive socket set usually includes sockets ranging in size from $\frac{1}{8}$ in. to $\frac{1}{2}$ in. The $\frac{1}{2}$ in. square drive socket set is designed for use on nuts ranging in size from $\frac{3}{8}$ in. to $1 \frac{1}{4}$ in.

A socket wrench set also includes various types of handles, which are so designed that nuts in normally inaccessible positions can be reached, and as a result the time for their removal and replacement is greatly reduced. The following types are usually included: reversible ratchet handle, extensions of various lengths, speeder, cross handle, hinge or flex handle.



TITLE: Glossary of Upholstery Terms

Page 1 of 11 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

ACCORDION PLEATS: Narrow, straight pleats usually paralled to one another.

BACKING: A strip of linen or other material placed on the underside of part of a garment to take the strain.

BACKSTITCH: A reverse stitch used in a bar tack, or at the beginning and the end of a seam for reinforcement.

BASTE OR BASTING: Tacking with long stitches to hold garment parts together. Sometimes a garment is basted together for a first try-on.

BINDING: 1) Covering the edge of a seam with an additional piece of material. 2) Bias tape used to fold over and cover a seam. 3) Excessive friction action of a moving part.

BLADE: The long, slender section of a needle, extending from the shank to the eye.

BLINDSTITCH: A stitch not easily discerned on the surface of a seam.

BOBBIN: A spool containing the entire mass of lower thread in lock-stitch machines.

BOBBIN CASE: The container for the bobbin permitting the bobbin to unwind as required. The case usually includes a tension spring that can exert the correct amount of tension on the lower thread to insure an ideal stitch. In some types of shuttles and hooks, the function of the bobbin case is designed into shuttle or hook body, eliminating the need for a separate case or case holder.

BOBBIN CASE HOLDER: That part of a shuttle or hook that holds the bobbin case in a stationary position, permitting the bobbin to unwind within it and the shuttle or hook to revolve around it, during stitch formation. The bobbin case holder is held within, but not fastened to the shuttle or hook.

BONDED FIBER FABRICS: A structure consisting of one or more webs or masses of fibers, held together with a bonding material, widely used for interlinings.

- BOOK SEAMS:** Seams which are not bound with piping, but are turned under. Approximately one inch more fabric is required for this type of seam.
- BOX PLEATS:** Pleats accomplished by alternating the direction of folds in the garment.
- CALIBRATED:** Accurately termed and specific distances; measured against a recognized standard, marked upon a part.
- CANVAS:** A closely woven fabric used as an interlining in men's and women's jackets and coats. Canvases are made from cotton, flax, hemp, jute and man-made fibers (see "INTERLINING:").
- CAPACITY:** The maximum thickness of plies of material that can be stitched on a machine.
- CHAINSTITCH, Single-Thread:** A series of stitches formed by a single thread (carried by a needle), having the loop in each stitch drawn forward to be caught by the passage of the loop in the succeeding stitch. The succession of loops regularly formed, beneath the material being sewn, has the appearance of a chain. This stitch ravel's easily and has extreme elasticity.
- CHAINSTITCH, Two-Thread:** A series of stitches, formed by an upper (needle) thread and a lower (looper) thread, having the loops of the upper thread interlaced and interlooped by the lower thread beneath the material. This stitch has the appearance of a double chain. It has great elasticity and is not as easily raveled as the single-thread chainstitch.
- CHALK, TAILOR'S:** A piece of flat pipclay, either square or triangular in shape, used for marking cloth, and colloquially known as clay.
- CLOTH:** Any woven material may be described as cloth, but in the tailoring trade the word "cloth" is usually applied only to the principal or outside material of a garment.
- DRAPE:** The way cloth falls when hung. The draping quality varies with the structure, composition and finish of the material.
- DROP STITCH:** (similar to "SKIPPED STITCH") A chainstitch in which the loops are not caught by their successive loops, i.e., no stitch is actually formed.

"E" STITCH: A rare form of zig-zag stitch in which the sidewise stitch movement is not diagonal but perpendicular to the lengthwise stitching, producing a blindstitch effect or "E" pattern.

EVER-LOK* STITCH: A single-thread lockstitch formed in the following manner: Thread is drawn from a supply through the needle and wound upon a bobbin in the lower thread carrier. After a sufficient amount of thread is wound upon the bobbin, the needle rises from the material and the material is moved one stitch length. The needle penetrates the material to its lowest position and then starts to rise again, forming a thread loop. The loop is passed around the bobbin and is locked in the center of the fabric in the same manner as in a basic lockstitch. The machine continues to perform as any lockstitch machine for the remainder of the sewing operation, or until the thread wound upon the bobbin is exhausted, whereupon the bobbin-winding and the stitch-starting process is repeated.

FABRIC: An alternative name for cloth in the broad general sense, but in the needle trade normally limited to cotton and silk materials. A material which is knitted or woven with bonded fiber, or is made from a combination of manufactured textiles, fibers and yarns.

FEED: A mechanism for repeatedly moving the material being stitched from one stitch position to the next at regular intervals.

FEED DOG: The flat-toothed plate of the lower feeding mechanism that grips and moves the material.

FEED-DRIVING MOTION: The forward movement of the feeding device.

FEED-LIFTING MOTION: The rising movement of the lower feed at the beginning of the forward stroke.

FEEDMARKING: Undesirable impressions left by the teeth of the upper or the lower feed on the material being stitched.

FEED PLATE: A feeding device above the machine bed, used instead of a feed dog. The feed plate has the appearance of a needle plate, but is designed with raised serrations about the feeding area to grip the material. The feed plate is driven along the bed and across the bed, as required, for a particular operation.

* A Trademark of The Singer Company

FEED SLIPPAGE: Failure of the feed to grip the material sufficiently for positive feeding.

FRONT: That side of the machine which faces the operator during sewing.

GATHERING FEED: A special feed mechanism (or a modification of a regular feed) which feeds the material toward the needle at a greater speed than the stitched material is fed away from the needle.

GEAR SHIFT: A stitch length regulating device using a set of different size gears, each of which has a recognized stitch length function, and a means to shift the feed driver to the gear that will produce a desired stitch length.

GRADING: The art of producing patterns in a range of different sizes from a master pattern.

GRADUATED: A set of markings, not necessarily numbered or even accurately determined, to indicate arbitrary degrees of measurement on a part.

GRAIN: The direction of the warp of the fabric. Cutting straight grain means cutting with the grain (along the way). Cutting cross grain means cutting across the grain.

GROOVE: The cut-in areas along the blade of a needle in which the thread rides during needle penetration. The thread is inserted in the eye of the needle from the "long-grooved" side.

HALF-HITCH: An imperfect lockstitch in which one thread (usually the needle thread) is looped around the other thread which lies flat, or nearly flat, with no loop of its own.

HAND WHEEL: 1) The wheel on industrial sewing machines that is reserved for hand driving only 2) The wheel on all family sewing machines whether or not it is operated by belt as well as by hand.

HANDLE: The feeling of a fabric to the hand.

HEAD: The entire sewing machine, not including motor, stand, accessories or attachments. (See "SEWING HEAD")

HEAD-END: The beginning of a piece of woven fabric.

HEEL: That part of the presser foot farthest away from the oncoming material.

INTERLINING: A layer of material inserted in certain parts of the garment between the inner and outer fabric for shape retention, strength, warmth, or bulk.

INTERLOCK STITCH: Variations of a covering stitch, in which an auxiliary thread-carrying finger lays a covering thread back and forth between the needles on the top surface of the material being stitched.

KNIFE PLEATS: Pleats in which material is folded over and stitched into a seam. The folds are in one general direction.

LATERAL MOTION: Movement across the cylinder bed or in line with the short dimension of the flat bed of a sewing machine.

LAY: A predetermined number of piles of material spread out on a long cutting table from which identical parts are cut simultaneously.

LAYING UP: Making a lay by machine or by hand.

LEATHER POINT NEEDLES: Needles of many varied point styles for stitching leather and non-fabrics.

LOCKSTITCH: A series of stitches, formed by an upper (needle) thread and a lower (bobbin) thread looped together with a lock of threads in each stitch equidistant from the top and bottom surfaces of the material being stitched. This stitch is non-raveling and has less elasticity than other types of stitches.

LONG GROOVE: A protective channel on the needle for the thread which is drawn from the take-up.

LONGITUDINAL MOTION: The movement along the cylinder bed or in line with the long dimension of the flat bed of a sewing machine.

MACHINE BED: The sewing platform of a machine that supports the throat plate, work clamps, guides, cloth plate and upright arm, and covers the lower feed and the lower thread mechanisms.

MACHINE PULLEY: The wheel on an industrial sewing machine that is rotated by a belt from an outside source of power.

MARKING: Indicating cutting lines of a garment on the top of a lay with soap chalk, using heavy paper patterns as guides.

MAXIMUM SPEED: The highest speed at which a sewing machine is mechanically capable of sewing. The maximum efficient speed is dependent upon the capability of the machine, the training of the operator, and the peculiarities of the sewing operation.

NEEDLE: A slender, pointed instrument, usually made of tempered steel, containing an eye to carry thread through a fabric in sewing.

NEEDLE BAR: A bar or lever, usually set vertically in the sewing machine head, which holds the needle by means of a clamp or set screw. The needle bar makes one stroke (up and down) with each revolution of the arm shaft.

NEEDLE GUARD: A device used to prevent the loop-taking point from striking the needle.

NON-ADJUSTABLE ECCENTRIC WITH ADJUSTABLE LEVERAGE: A stitch regulating device that consists of a feed eccentric fixed on the arm shaft with a lever riding upon it. The operator increases or decreases the stitch length by moving the lever at its fulcrum point.

PATTERN (CUTTING): A hard cardboard in the shape of a garment part, which is placed on the material and then outlined with pencil or crayon, leaving the outline of the part on the cloth.

PATTERN WHEEL: A cam wheel with a designed groove on its face, to guide a follower that in turn actuates other parts in a cycle of movements.

PENETRATION: The first step in the formation of all stitches: the entrance and the passage of the needle and the thread through the fabric.

PINKING: Zig-zag edge cutting of material to prevent raveling or fraying.

PIPING: A narrow bias tape used in binding.

PLEAT: A fold of material sewn into a seam to take up excess cloth.

- PLY: Cloth:** The number of thicknesses of cloth in a lay or a seam.
Thread: The number of strands in a twisted cord, thread or yarn.
- POINT:** The penetrating end of a needle.
- PULLER FEED:** An additional feed mechanism used to assist the regular feed in carrying stitched material away from the needle.
- PULL-OFF:** A thread control used in chainstitching to draw enough thread from supply for the next stitch.
- RACE:** 1) A channel in which the shuttle rides as it carries the lower thread through the needle thread loop. 2) The channeled section of a sewing hook, which rotates around the bobbin case or the bobbin case holder, and on which the hook point is mounted.
- REPLACEABLE (NON-ADJUSTABLE) ECCENTRIC:** A stitch length regulating device that consists of easily identifiable eccentrics or cams that can be interchanged on the feed-driving shaft to change the stitch length.
- REVERSIBLE FEED:** A mechanism making it possible to reverse the feeding direction at the will of the operator.
- ROTARY HOOK:** The lower thread carrier that rotates continuously in one direction, making two revolutions for each stitch. During the first revolution, the hook passes the needle thread loop, not around itself, but around the stationary bobbin case containing the entire mass of lower thread. The thread loop is reversed (twisted 180°) by a thread guard after the loop has enclosed the bobbin thread (usually at cast-off). The loop is cast off at the end of the first revolution. The hook continues on a second revolution, free of needle thread while the lower thread and the cast-off needle thread are being drawn and tightened to form the stitch, and while the needle is descending to penetrate the material and form the next thread loop.
- RUNNING YARD:** A yard measures the length of the fabric, regardless of its width.
- SATIN STITCHING:** A series of very closely spaced zig-zag stitches that form a smooth, satin-like surface.

SEAM: A joint or ridge, made where two or more plies of material are sewn together.

SEAM SLIPPAGE: Yarns pulling away from a seam.

SEW: To work upon with a needle and thread, so as to mend or fasten together two or more plies of material, or to embellish a fabric with a pattern of stitched thread.

SEWING HEAD: That part of the machine arm containing the needle bar, the presser bar and other upper thread and upper feed devices above the throat plate. (see "HEAD")

SEWING MACHINE: A mechanical unit containing a system of determined and coordinated motions of thread-handling and material-feeding devices designed to sew, mend or fasten together two or more plies of material or to embellish a fabric with a pattern of stitched thread.

SHOE: That part of a presser foot designed to contact the material.

SKIPPED STITCH: A stitch that appears twice as long as the others in a line of stitches and is caused by failure in the stitch formation. It allows the thread to be returned to the surface and feeds out to the next needle perforation.

STAGGERING: An imperfect line of stitches, caused by the springing or the deflecting of the needle or by feed dog sway.

STAY STITCH: (same as "BACKSTITCH")

STEALING: An excessive withdrawal of thread from a supply, due to faulty controls.

STITCH: A single unit in a series of arrangements of thread, or threads, continuously passed through one or more plies of material at uniformly spaced intervals and in a determined pattern style, for purposes of sewing or decoration.

STITCH REGULATOR: A device to assist the operator in setting the length of stitch (or distance between needle perforations).

STITCH SETTING: The final step in the stitch formation: the thread or threads, drawn upward and tightened, fasten the stitch in the material.

STRAIN: A change in shape or size caused by some outside force.

STRESS: Any force that can change the shape or size of a part.

STROKE (FEED DOG): The stroke is the length of the forward motion of the feed dog, which determines the number of stitches per inch. The longer the stroke, the less stitches per inch. The shorter the stroke, the more stitches per inch.

STROKE (SEWING): The length of material that an operator can feed in without stopping. (On some rare operations the stroke can be continuous.)

TAILOR'S STITCH: A backstitch covering the whole of the surface between stitches, with the thread exposed on the face and underside of the material.

TENSION: The degree of tautness in thread, cloth or spring metal part.

TENSION RELEASER: A device designed to relieve tension on the thread whenever the presser foot is raised.

TENSION SPRING: The spring which exerts an adjustable degree of tension on the thread.

TENSION SPRING ASSEMBLY: The entire needle thread (or looper thread) tension mechanism, including the knob or regulating nut, tension spring, two or more concave discs, a stud and a take-up spring. It is used to exert an even, constant "drag" on the thread.

THREAD: A slender cord composed of two or more yarns twisted together. A yarn consists of many filaments of fibrous substances, twisted together. (see "YARN")

THREAD CONTROLLER: 1) Any device used to control the thread in its passage toward the needle or the lower thread carrier.
2) Specifically used to designate "Slack Thread Regulator".

THREAD COUNT: The number of threads per square inch of woven fabric.

THREAD GUARD: An instrument to insure that the needle thread loop forms on the correct side of the needle to be penetrated by the lower thread carrier. The loop may bulge on the wiring side of the needle unless the thread guard pushes upon the incorrect bulge causing it to pass through the needle eye to the correct side.

THREAD SPLITTING: The separation of strands of a sewing thread.

TRANSVERSE MOTION: The movement across the line of feed.

TRAVERSE: 1) Passage of the top thread over the lower thread carrier in the stitch formation. 2) Face of the bobbin, bobbin case and shuttle over which the top thread passes in the stitch formation.

TREADLE: A foot pedal which controls the motor and, therefore, the speed of the machine. It may also be attached to a brake which will stop the machine instantly if pressure is applied in the heel area.

TRIM MARGIN: The distance from the center of the needle penetration point in a fabric to the edge of the trimmed fabric. The trim is often measured from the center of the needle to the cutting edges of the trimmer knife.

TURNING: Basting two pieces of material together, then seaming and turning the seam inside out.

UNDER-WHEEL FEED: A lower driving feed, using a wheel that is in constant contact with the underside of material. The drive may be intermittent or continuous.

UNISON FEED: A compound feed consisting of a vibrating needle bar, a feeding foot, a lifting foot and a bi-motion feed plate which vibrates flush with the surface of the throat plate. Vibration of all feeding parts is always on the line of stitching. The needle descends through the material and the needle hole in the feed plate at the same time that the feeding foot contacts the material. All move together along the line of stitching. The lifting foot then contacts the material holding it firmly while the needle and the feeding foot rise, and the feed plate returns to the start of the next stitch.

UNIVERSAL UPPER FEED: A mechanism, without an under feed, in which the feeding is accomplished entirely by a positively driven feeding foot which alternately engages and disengages the upper side of the material and permits a change of feeding direction at will.

UPPER FEED: Material fed entirely by means of a positively driven feeding foot which alternately engages the top side of the material.

UPPER AND UNDER FEED: Feed designed with drop feed operating in unison with a feeding foot.

UPPER AND UNDER WHEEL FEED: A feed design with two wheels in constant contact with material.

UPPER WHEEL FEED: An upper driving feed using a wheel that is in constant contact with upper surface of material. The drive may be intermittent or continuous.

VIBRATING FEED: Any feeding device that feeds materials from side to side rather than forward.

WADDING: A soft mass or sheet of short loose fibers used for stuffing or padding, such as quilts, costumes, upholstery, or packages.

WARP: The yarns that run lengthwise in a fabric.

WELTING: Sewing a cord or a fold on the edge of a garment to strengthen it.

WHEEL FEED: A driving feed (either upper, lower, or both) using a rotating cylinder and usually in constant contact with the material during a sewing operation. (See "CONTINUOUS", "INTERMITTENT", "UNDER", AND "UPPER" Wheel Feeds)

X-STITCH: A button-sewing pattern of stitches having the appearance of the letter "X". It is used infrequently in four-hole buttons and is usually called the "cross stitch".

YARN: Filaments of cotton, wool, silk or other organic fibers that have been brushed, combed, carded, aligned into uniform loose strands and then twisted together. One yarn alone is called a single. When two or more singles are twisted together, they become a thread or cord.

ZIG-ZAG STITCH: A stitch formed exactly the same as a basic lockstitch. The successive stitches, however, are placed at an angle to each other instead of in a straight line.

TITLE: Upholstery Materials

Page 1 of 3 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

The materials used in upholstery are derived from a variety of sources and are gathered from many parts of the world. Most of the cotton the upholsterer uses is produced in the United States, while most of the burlap comes from Calcutta, India and Dundee, Scotland. Kapok--the very useful material for stuffing camping mattresses, pillows, boat cushions--grows best in Java. While raw materials for curled hair comes largely from South America.

The manufacture of some of the many varieties of cloth used in upholstery are among the world's most ancient industries while for example in plastic coverings, foam rubber and polyfoam are very modern. So upholstery combines the old and new from all corners of the earth.

Upholstery Webbing

Upholstery webbing is made entirely of jute fiber. This fiber is especially adapted to the purpose because it has very little elasticity. When properly secured jute webbing will stay in place and preserve the shape of the cover for a long period of time.

Burlap

Burlap is the plain cloth, usually woven from jute yarn. Although Calcutta, India, is the world's largest burlap manufacturing center, large quantities of jute fiber are shipped directly to the United States in a state ready to be woven into burlap and webbing. For upholstery purposes, burlap is used for covering springs, making roll edges and stitched edges and for covering webbing where no springs are used. Grades of burlap are determined by the weight per yard. The standard-width burlap--40 inches, 8 oz. weighs 8 oz. per yard, 10 oz. weighs 10 oz. per yard and so on.

Denim

Denim is a strong twilled cotton fabric of superior wearing qualities. It is woven of single yarn, both in warp and filling. It is made frequently with a mottled surface, that is, dark blue, grey or brown with flecks of white. It also comes in plain covers and sometimes a small pattern is woven into it. Lighter denims for upholstery work are used on seats for covering of springs.

Muslin

For upholstery work, unbleached muslin is used as a first covering over the stuffing. The use of muslin permits pulling the stuffing to its desired shape and firmness before putting on the covering.

Cotton Felt

On the upholstered seat, cotton felt is used chiefly to stuff spring-filled, loose cushions. It also is used over all other loose upholstery filling to prevent the dust from the filling and the hair or filling ends from coming through the upholstery cover.

Vinyl Plastic

Vinyl plastic, called by various trade names Naugahyde, are synthetic resins derived from limestone, coal and salt. The plastic is a white powder resembling cornstarch or flour and when properly compounded, it has many of the characteristics of rubber.

The powder is mixed with stabilizers, plasticizers, color pigments and other ingredients needed for specific qualities. This group of raw materials is thoroughly mixed in a machine and then further blended under high heat and pressure. The high temperature softens the ingredients into a doughlike mass. This operation is called "calendering". The surface of the calendered material is then printed, embossed, two-toned or left as a plain color.

Plastic can be purchased with a strong fabric backing to provide strength and durability for long-lasting, trouble-free service. Not a surface coating, it is mechanically fused into the fabric for permanent adhesion.

Plastic is tough in resistance to abrasion; it is soft and pliable for neat tailoring in upholstery; it contains nothing to dry out; and it will not crack or split. It will not deteriorate with age, since it is not affected by heat, cold, sun, oil or grease.

Plastic needs no special care. If it becomes spoiled, it can be made like new by washing with a mild soap and warm water, followed by a polishing with a dry cloth. An occasional damp cloth wiping will keep the colors fresh and new looking.

The advantage of upholstering with this type of covering is the ease with which it can be applied since the backing is a knitted fabric that can be stretched eight ways. Round and oval pieces can be put on as easily as the square pieces.

Sponge Rubber

Sponge rubber is made of latex, which is the milk of the rubber tree. Latex is collected on plantations in Sumatra and Malaya and is shipped to the United States in liquid form.

At the rubber manufacturing plants, some chemicals are added to assist in curing and to resist aging, as well as to form a spongy structure.

The latex is then whipped into a creamy froth, causing it to foam. The procedure is like making a hugh cake; that is, the more air bubbles there are, the lighter and softer will be the finished product. The material is then cured. After it has reached its proper consistancy, it is poured into metal molds of various sizes and shapes and placed into huge ovens to bake under heat and pressure. It is then taken from the molds, washed to remove all impurities and dried. The result is a clean rubber cushion or pillow.

Sponge rubber is available in various forms and sizes to meet many requirements.

Polyfoam

Polyfoam is a new chemical foam development and especially adapted and extensively used as a cushion filler for seats and seatbacks.

Polyfoam is soft, resilient and has superior strength. It is not easily torn in handling. It can be cut or sliced easily. Pieces can be cemented together with special cement and it adheres readily to metal, wood and fabric. It is a light weight.

Twines

There are three kinds of twines used in upholstery:

1. Spring twine
2. Jute twine
3. Flax (stitching) twine

Thread

Left-twist thread should be used in the needle. Either right or left can be used in the bobbin.

Several kinds of thread used: cotton, silk, nylon-rayon.

INFORMATION SHEET
IL-1F-3

TITLE: Needles

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

Needles are available in sizes 9-26 and should be used in most machines. The needle size is determined by the size of the thread which should run freely through the needle eye. Rough and non-uniform thread that does not run freely through the eye interferes with the proper function of the machine. Also thread will shread and fray when too large.

TITLE: Tools and Equipment for
Upholstery

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT I: Metal Work

A basic requisite for successful work in upholstery is knowledge of the tools of the trade.

Tools

1. Upholsterer's Hammer - The upholsterer's hammer has a head about $5\frac{1}{2}$ inches long, with a face from $5/16$ to $1/2$ inches in diameter. Usually the one face is magnetic and the other a regular face. With a hammer of this shape, one can tack in deep corners without too much trouble.
2. Upholsterer's Shears - It is important that suitable shears be used, because most covering materials are quite heavy and the shears are used for cutting of covering fabrics, sponge rubber, burlap and webbing.
3. Upholsterer's Pin or Skewer - This pin is used as a temporary basting for covers. It enables the upholsterer to get covers on straight and to obtain the firmness desired before sewing or tacking the covering. It is also used to pin up cushion openings before sewing.
4. Upholsterer's Needles -
 - a. Curved - The curved needle, which may be from 2 to 8 inches in circumference, is used to sew flat surfaces where it is impossible to use a straight needle; that is to say, where using a straight needle would mean reaching on the other side of the job to push the needle back.
 - b. Straight - Straight upholsterer's needles are from 6 to 12 inches long. They are used to sew springs to webbing, stuffing to burlap, etc. They are double pointed to permit sewing down and up without turning the needle around.
5. Body Trimmer's Pliers - The body trimmer's (hog-ring plier) is used for closing the prongs of metal lock rings that fasten the seat upholstery coverings to the seat frames.
6. Spring Clip Pliers - Special pliers used to replace the special metal clips that secure the springs to the seat frame.

Equipment

Benches or Trestles - A set of benches or trestles for assembling or upholstering a section of seat if a padded table is not available. Trestles should be light enough for easy handling and at the same time strong enough to accomodate all kinds and sizes of seats. They should be constructed so that the seat will not slip off, and they should have either a pad on top or a stuffed roll edge all around the top to prevent damage to the upholstery. The best size is 36 inches long and 30 inches high with the top board 8 inches wide.

Sewing Machine - A sewing machine to be used for sewing upholstery covering should be of sturdy construction. This would be of industry type adaptable for the material.

TITLE: Seat Springs

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

When replacing upholstery and nonsagging spring, it is not necessary to tack and stretch webbing as a base, since these springs are fastened directly to the top of the frame. Each spring is fastened to the frame with special clips. These clips are made in various shapes for the different styles of construction. The clips are also insulated to prevent noises.

There are various sizes, wire gages, and types of springs used in upholstery. Each has a definite place and use where resiliency is required.

1. Upholstery springs. Upholstery springs are usually open at both ends. One end of the spring is bent toward the center when the spring is in place; this end should be on top. The tip is bent down so as not to wear a hole in the burlap or padding and thus permit the stuffing to fall into the springs. These are usually of 9 to 11 gage wire and are from 4 to 14 inches in height. They may be either soft spring or stiff spring. The soft spring has a wide center, and the stiff spring has a narrow center.
2. Nonsagging springs (also called hairpin or zigzag springs) are made in a continuous serpentine strip. These strips can be cut into the desired lengths. They also can be cut into the desired length. They also may be purchased cut to specified lengths with the ends bent, ready to attach. These are made in 7 to 12 gage wire. The heavier gages, 7 to 9, are used in seats, while the lighter gages, 10 to 12, are used in backs of seats.

TITLE: Automotive Glass

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT I: Metal Work

The raw materials for glass manufacture are now as they were in ancient times; sand, soda and limestone or chalk. From the chemical point of view glass consists of compounds of silicates with alkaling and alkaline earth oxides. After melting, glass with the correct composition and subjected to the right treatment (cooling) must not become crystalline or solidifying.

There are hundreds of recipes for making glass. One of these is the following: 59 parts of quartz sand, 17 parts of soda, 15 parts of dolomite, $4\frac{1}{2}$ parts of limestone, 3 parts of sodium sulphate and carbon, and $1\frac{1}{2}$ parts of felspar. These ingredients are intimately mixed together. 20 to 30 percent of cullet (broken waste glass) is added to this mixture, which is then melted in tank furnaces with capacities of up to 1,500 tons of material, or in pot furnaces containing a number of pots, each holding up to one ton of material, or in pot furnaces containing a number of pots, each holding up to about two tons of material. The melting soda forms low-melting alkali silicated with the sand; these silicates enter into further reaction with the high-melting constituents and form the final glass melt.

TITLE: Door and Glass Service
COURSE: Automotive Body and Fender

Page 1 of 10 Pages
UNIT I: Metal Work

A body man is required to service all types of glass on automobiles. He will not only have to service doors and glass after an accident, but also have to repair, change parts and align the windows. Many different types of regulators, locks, lock cylinders and vent assemblies are used, each with a specific function.

The front door on some automobiles have a vent-glass assembly and a window assembly; on others, usually late model cars, a one piece glass assembly is used. Since a one piece glass assembly is a new development, it will probably become more popular.

A tailgate glass is a one piece glass assembly that may be either straight or curved. Tailgate glasses are serviced in the same manner as door glass assemblies.

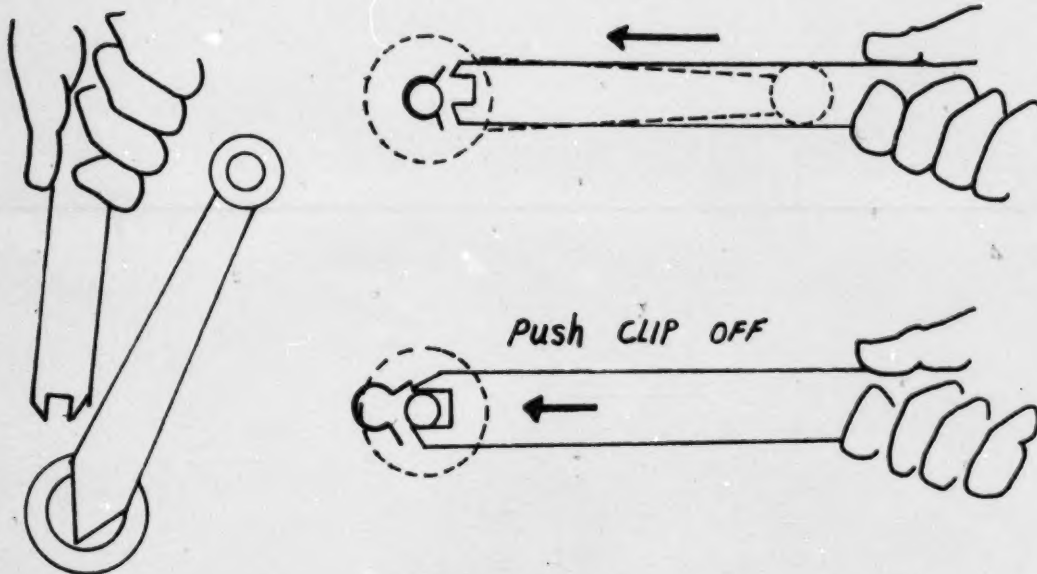
TO REMOVE CLIP-ATTACHED INSIDE DOOR HANDLES:

Inside door lock handles and window crank handles are held on with a small horseshoe spring clip that is easily removed with the right tool. The auto body man must often remove and replace door handles to make repairs to windows, locks, and doors themselves.

With the push-type tool:

1. Push in the trim panel around the handle until you can slip the clip removing tool between the panel and the handle. The tool must be between the handle and escutcheon plate--plastic washer.

2. The push-type tool is always slid in from the side. The end of the handle or crank must also be straight out.
3. Push the tool straight in until the clip is pushed back or removed.



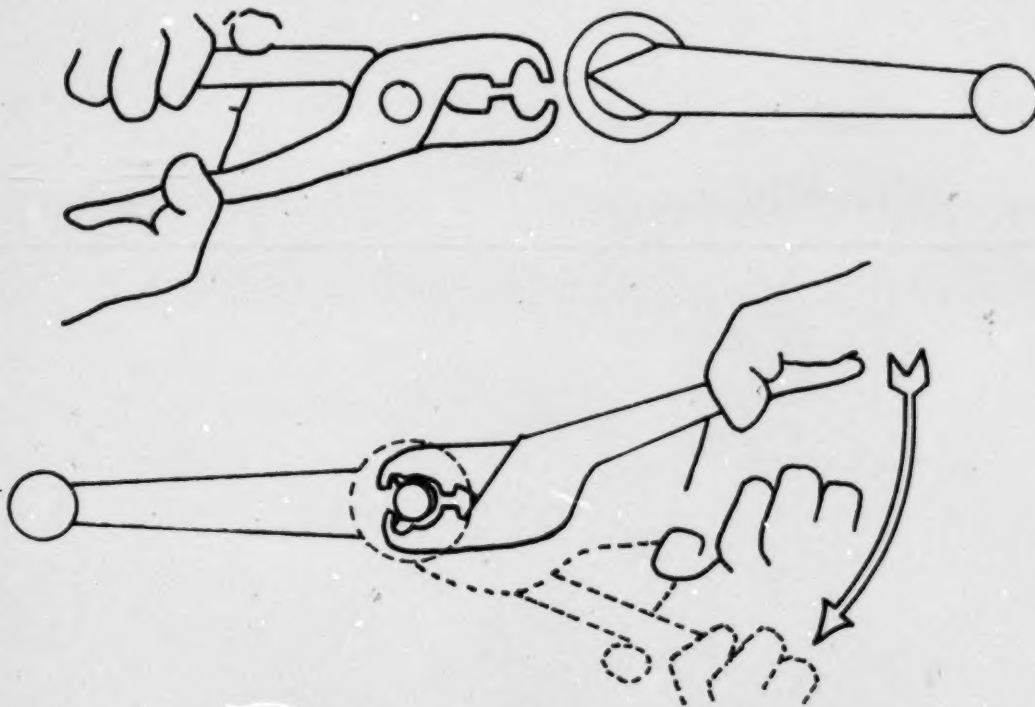
4. Remove the tool and pull off the handle.

With the plier-type tool:

1. Slip the tool in from the round or short end of the handle.

2. Hook the ends of the pliers around the ends of the horseshoe. Pull up and down on the tool until the clip is cut. Then pull the handle off.

NOTE: If the tool is not between the escutcheon plate--plastic washer--and the handle, it will not fit into the clip slot in the handle.



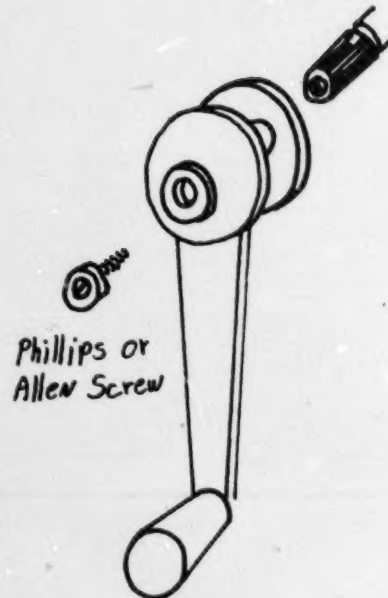
TO REMOVE SCREW-ATTACHED INSIDE DOOR HANDLE:

Ford car products use screws to attach handles and window cranks on some models of cars. Both Phillip and Allen head screws are used. The auto body man must know how to remove screw-attached door handles.

1. With the proper tool, remove the screw from the center of the handle.

2. Pull off the handle and the escutcheon plate.

NOTE: On late model Ford products a thin aluminum disc is in the center of the head of the handle or crank. This disc is removed with the point of a knife or a sharp pointed tool. This disc is often damaged when it is being removed so it must often be replaced. The screw head is under the disc.

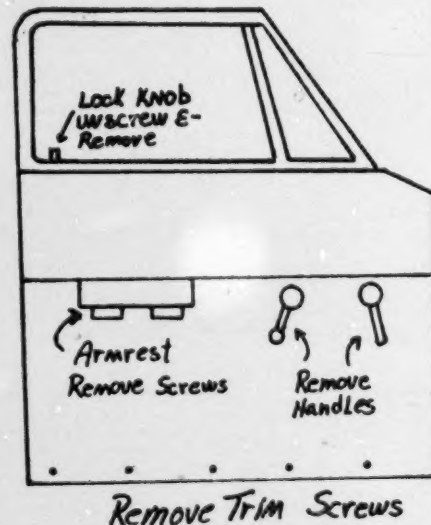


REMOVING INSIDE DOOR TRIM PANEL:

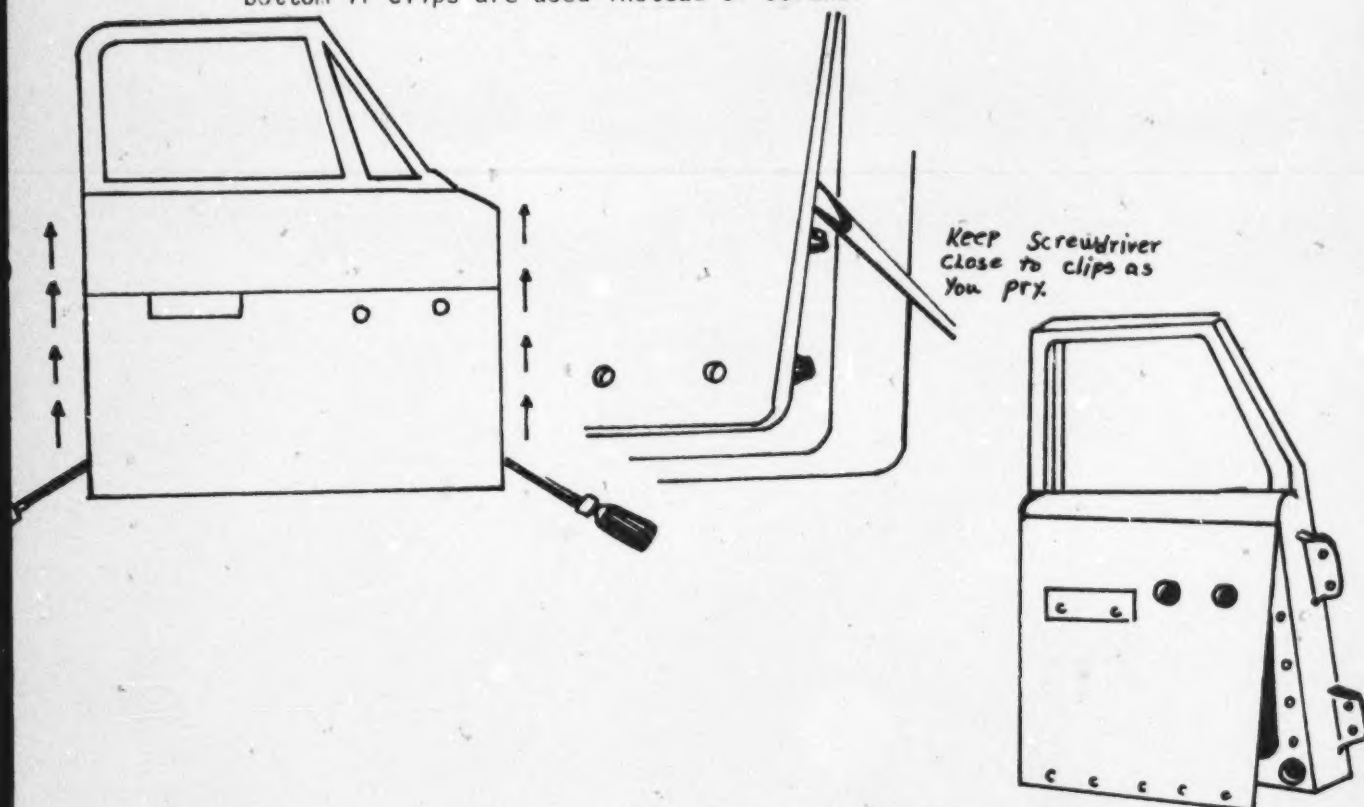
The auto body repairman must always remove the door trim panel to repair or replace any of the parts inside the door-glass, locks, etc. It must also be removed to straighten the panel. Panels are attached in several different ways. Look the panel over to find how it comes off. Remove the trim panel carefully-they are expensive and are easily damaged.

To remove the panel:

1. Remove the inside door lock and window handles.
2. Unscrew the inside lock mechanism knob.
3. Remove any trim screws which hold the trim to the door frame.
4. Remove the screws from the arm rest.

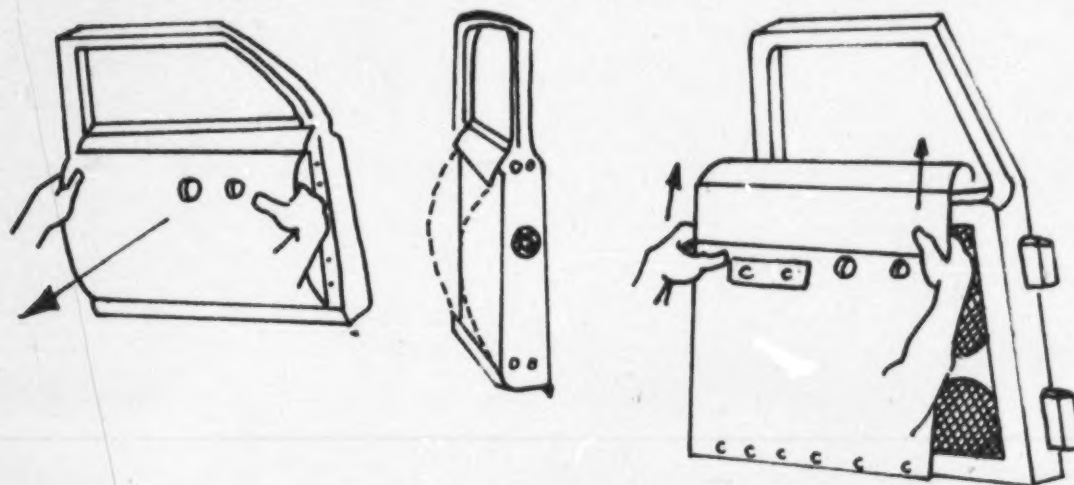


5. Slide a #1 blade screwdriver between the bottom of the trim and the bottom of the door frame.
6. Work the screwdriver between the trim clip or nail and the door frame.
7. Carefully twist the screwdriver to release the clip.
8. Work the screwdriver up each side of the panel and across the bottom if clips are used instead of screws.

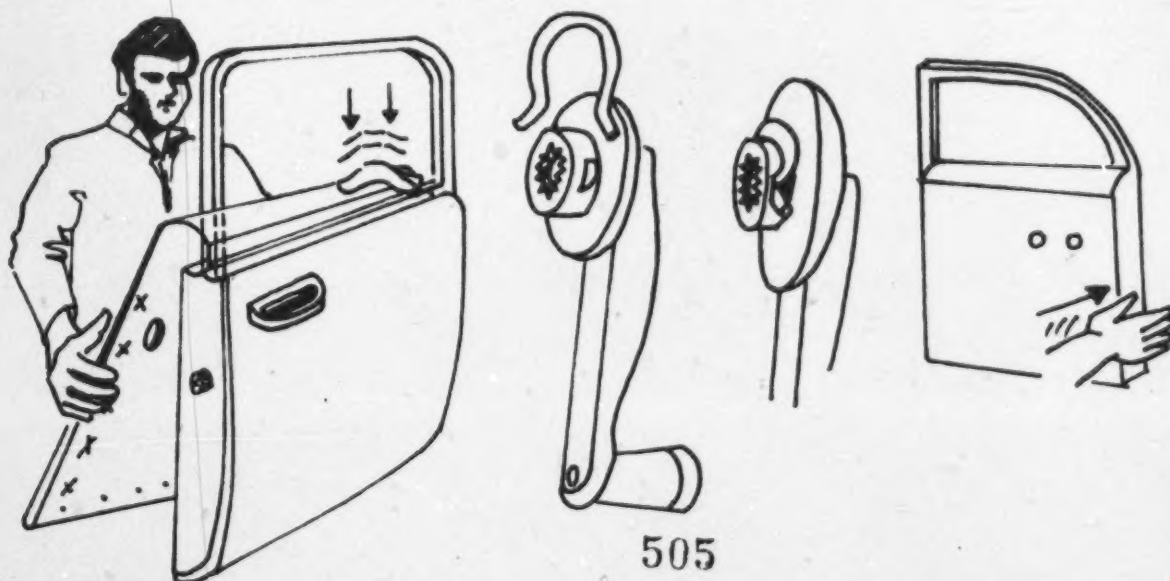


9. After all the clips or nails are released, pull out on the trim panel as shown. Then lift it straight up toward the top of the door. Use a slight side to side motion to release the panel from the top clips.

NOTE: On some compact cars, the trim is held at the top and bottom by a metal strip with clips on each side. To remove this type, loosen the side clips, then bow the panel out.



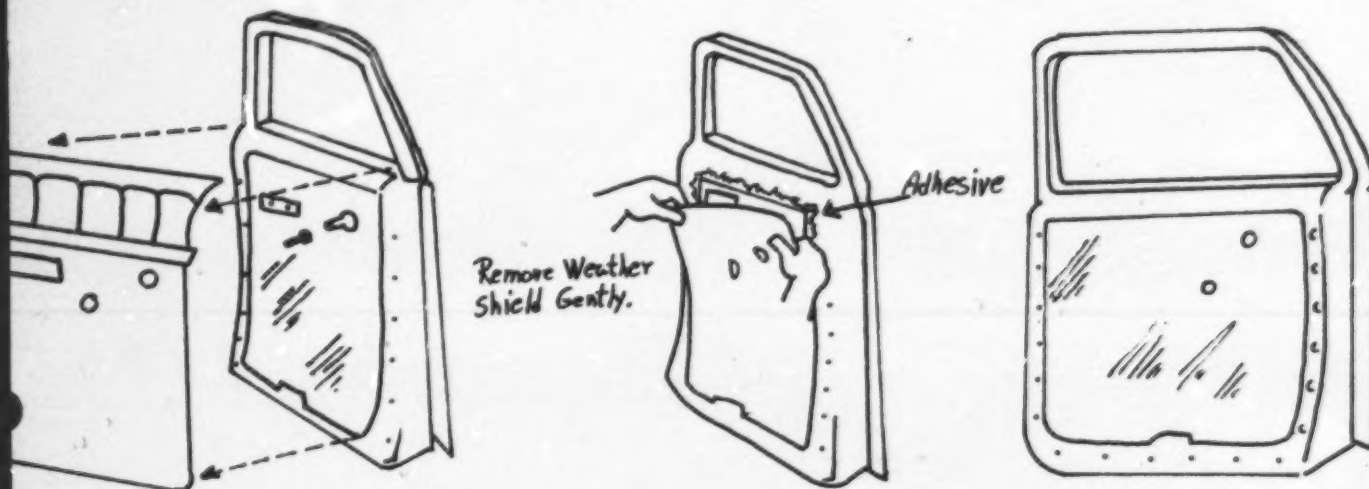
To replace the trim panel reverse the steps above. With top-hooking trim, start the trim panel down over the clips at the top. Then, with your hand, bump the panel down until the holes in the panel line up with the lock stems and the clips line up with the holes in the door. Be sure the clips or nails are started into the holes then bump them in with your hand. Replace the armrest and any trim screws. Replace the lock handle and door glass regulator handle. Put the clip in the handle before putting it on the stem. Put the handle on the lock or regulator stem in correct position and bump it on with your hand or a light tap with a rubber hammer.



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REMOVING AND REPLACING THE WEATHER SHIELD ON DOORS:

The weather shield on doors is a plastic or treated paper that is cemented to the inside of the door under the trim panel to keep water from leaking on and ruining it. After the trim panel is removed, carefully pull the weather shield from the door.

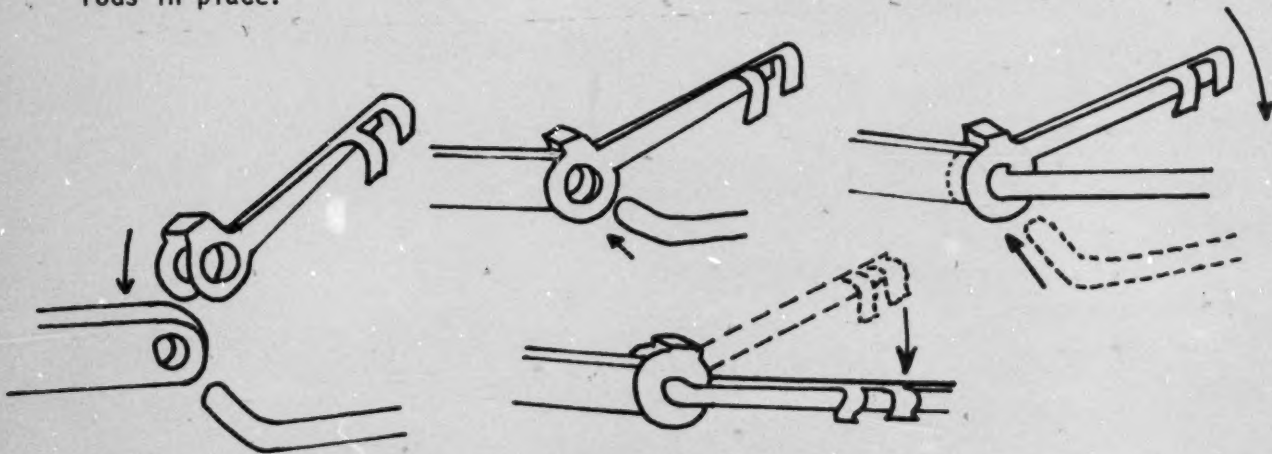


Before you replace the trim panel, be sure to replace the weather shield by pressing it back onto the adhesive or hold it in place with masking tape. It is important to be sure the bottom of the shield is in place. Tuck it into the slots at the bottom of the inside of the door. This will let the water drain into the bottom of the door and will not let it come out in the trim panel.



REMOVING DOOR INSIDE LOCKS, REGULATORS, GLASS AND GUIDES:

To remove the mechanisms from inside the door, you usually have to remove the glass. If the door has a vent glass, it is usually removed first to make room to remove the door glass. The door glass is fastened to the glass channel or regulator arms with screws or clips. After the glass is free of the channel, it is removed from the top of the door. All other parts are removed through the access holes in the inside of the door. Adjustment and adjustable runways are bolted to the door inside panel through slotted holes. Lock rods are attached to the locks by special clips and must be replaced correctly to hold the rods in place.

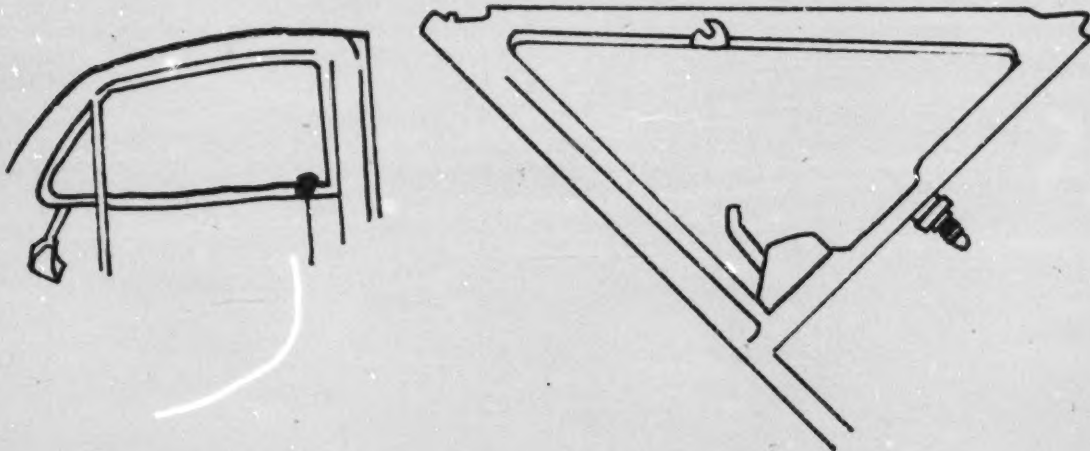


Always check the operation of parts after you replace them and run the glass up and down to check for correct alignment and operation.

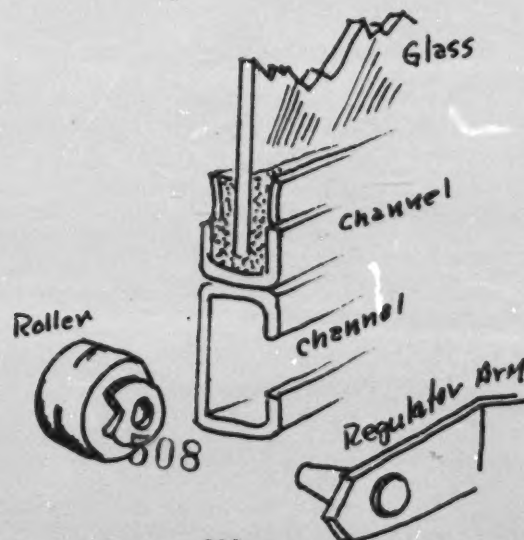
Never force any of the parts when you are removing or replacing them. A slight bend will ruin the alignment of the parts.

REMOVING VENT AND DOOR GLASS:

If a door has ventilator glass, the vent glass assembly must be removed before the door glass. To remove the vent glass assembly, remove the vent glass regulator (if there is one) by removing the fastening bolts and the bolt that fastens the vent glass frame pivot bolt to the regulator. Remove the screws that hold the vent frame to the door frame (not necessary on hard tops). Remove the adjusting bolts from the division bar. Work the vent frame and division bar up out of the door.



After the vent glass is removed, disconnect the glass channel from the window regulator. If the car has a clip and roller, remove the hairpin slip to free the roller from the regulator arm. On many G.M. cars, the channel is held to the regulator by some kind of screws. After the glass is free, lift it up and out of the door. On some cars you have to remove the weather strips to make room for the glass channel to clear the door frame.



INSTALLING AND REPLACING DOOR PARTS:

Often the auto body man has to remove and replace--with new parts--the parts of a door. The parts are mounied inside the door and there is not much room to work. The parts must be removed and replaced in order because some overlap others. Doors on cars of different years and makes vary in construction and parts. The parts are held to the door inner panel with screws or small bolts. When the glass channels or rods are held by hairpin clips, make sure they are securely in place so they don't come loose after the door is put together. All parts should be put in place with the screws or bolts loose so adjustments can be made before tightening. Make sure the glass raises and lowers without catching and be sure there is a good seal when the window is up.

TITLE: Windshields, Rear Windows and
Quarter Glass Station

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COURSE: Automotive Body and Fender

UNIT I: Metal Work

Frequently windshields and back windows are broken in collisions and roll-overs or because of the twisting of the car body. Windshields are also broken by flying gravel, by vandals or are pitted by a sandstorm or industrial causes.

The windshields and back windows are usually held by a rubber weather-strip or a special adhesive (butyl) tape. Generally moldings exist on the inside of the body around the opening and on the outside. The inside moldings are called garnish moldings by some companies and the outer moldings are called reveal moldings. Still other companies have other names for these moldings. Thus, depending on the type of car being worked on, the proper term must be used when ordering parts.

The removal and replacement of the windshields and back windows follow the same methods rather closely. Methods may vary slightly for different makes of cars; however, many of the operations that are applied to one make of car can be applied to others as well. One of the main things to remember is to cover the seats, the dash and the hood with a protective covering so as not to damage the upholstery and paint.

REMOVING AND REPLACING ADHESIVE OR CEMENT IN TYPE GLASS:

1. Punch hole in adhesive between glass and pinch weld.
2. Insert hot knife tip between pinch weld and glass.
3. Work knife completely around window.

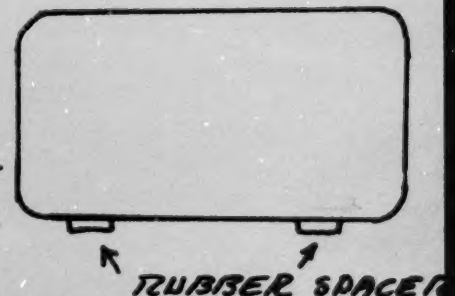
NOTE: Caution must be used to prevent glass breakage.

NOTE: If using piano wire place through hole as in Step 2 and pull wire in sawing motion completely around glass.

4. Remove glass.
5. Clean pinch weld.

NOTE: If reusing old glass remove all old adhesive.

6. Place rubber spacers on bottom of window opening.

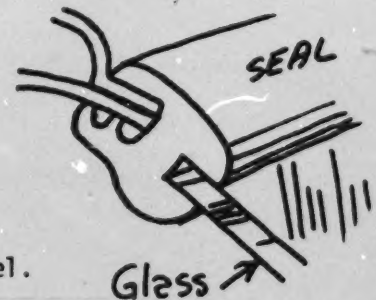


7. Apply adhesive to pinch weld.
8. Place glass in position and press into place.



REMOVE AND REPLACE RUBBER CHANNEL TYPE GLASS

1. From the inside, tuck rubber channel over pinch weld, starting at top edge and working across and down.
2. Remove window.
3. Clean rubber channel and pinch weld.
4. Apply window caulking on pinch weld.
5. Place rubber channel on new glass.
6. Place strong cord in channel insert of rubber channel.
7. Take ends of overlapping cord to inside and tape in place.



8. Place glass with channel into window opening.
9. Holding glass firmly against pinch weld pull string down bringing rubber channel over pinch weld.

TITLE: Safety Related to Paint and
Spraying

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

Safety as it relates to paint and spraying involves the health and safety of the student in the shop. There are seven areas which are listed below and information for each.

FLASH POINT:

The flash point of a liquid is the temperature at which the saturated vapor will ignite in the presence of a spark or flame. Most solvents have a flash point normal ambient temperature so it follows that extreme care must be exercised to prevent ignition.

VAPOR AIR RATION:

The mixture of vapor and air must be in the proper proportions to produce an explosive or flammable concentration. If the mixture is not correct, combustion will not occur even if a source of heat is present. Paint spray operations tend to form higher vapor-air concentrations than brush painting; therefore spray painting in confined areas require better ventilation.

VENTILATION:

Adequate ventilation is required when working with flammable solvents to remove the toxic vapors developed and to prevent the formation of a combustible mixture. Ventilation is required until the coating is dry to the touch. This is especially important when spraying in confined areas.

HEALTH HAZARDS (TOXICITY):

Most of the solvents and some other ingredients contained in paints or cleaning agents act as catalysts and are toxic in varying degree. They act upon the human body as poisons, anesthetics and irritants. The quantity of vapors released by solvents depend on the type, the ambient temperature, and location, i.e., outdoors or confined areas. Solvents with low flash points will evaporate more rapidly and have a tendency to be more toxic. Enamel thinner, toluene, xylene, and methyl-ethyl-ketone are more toxic than mineral spirits. Turpentine and methyl-ethyl-ketone are very irritating. Benzol (benzene), methyl-cellusolve, and methyl-cellusolve-acetate are the most toxic solvents used. They can cause serious, even fatal injury to the body and must not be used unless proper precautions are taken.

SKIN IRRITATION:

The absorption of many solvents through the human skin will produce many systemic effects, such as dermatitis. Some vapors are strong irritants to the skin. Alkali or acid liquids may cause severe burns.

DUST TOXICITY:

Toxicity of dust from surface preparation. This occurs by inhalation or ingestion and/or by the settling of dust on the skin. These toxic dusts are formed during wire brushing, chipping, scraping, grinding and sand blasting operations.

PERSONAL HYGIENE:

Workmen must wash exposed areas of their body thoroughly with soap and water before leaving the job as well as before eating. Keep hands out of cleaners, solvents and thinners.

TITLE: Paint Surface Preparation Equipment

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

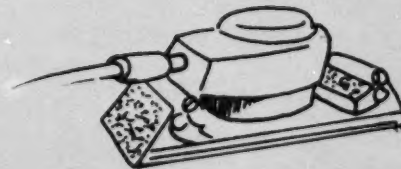
There are several types of equipment used in preparation of a surface for refinishing. The equipment is operated either by electric or air. The air sanders are:

1. Orbital sanders (usually called vibrators). These are used for feather-edging sanding or block sanding.
2. Dual-action sanders (usually called "DA"). These are used for feather-edging, and over all preparation for refinishing a car.
3. Orbital speed file sanders. These are used for feather-edging, and block sanding putty, plastic.

(All of the above require 60 to 90 psi air pressure to use.)

The electric sanders are:

1. Orbital sanders, used for feather-edging and block sanding.
2. Orbital speed file sander, used for feather-edging and block sanding, putty and plastic.
3. Belt sander, used for feather-edging and block sanding, putty and plastic.



TITLE: The Spray Gun

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The spray gun is a precision instrument and should be treated as such. It is constructed as accurately and tested as carefully as precision tools and gages. Neglect and carelessness are responsible for the majority of spray gun difficulties.

The purpose of a spray gun is to combine paint and air under pressure. The air pressure atomizes, or breaks up, the paint stream into a controlled spray pattern.

PRINCIPAL PARTS OF A SPRAY GUN:

1. Air Cap-

The air cap is located at the front of the gun. It directs the air into the paint stream to atomize the paint into a suitable spray pattern.

All caps can be divided into the categories internal or external mix. In an internal-mix air cap, the paint and air are mixed inside the cap and then ejected through a center slot. The use of this type of air cap is limited to slow-drying materials that will not build up and dry inside the nozzle.

In an external-mix air cap, the air and paint are mixed approximately 5/8 inch out from the face of the air cap. This air is ejected through two horn orifices, a center orifice, and, sometimes, auxiliary orifices. The horn orifices direct the air that determines the size and shape of the spray pattern and supplies 20 to 25 percent of the air needed to atomize the paint stream. The center orifices and auxiliary orifices supply the other 75 to 80 percent of air needed to completely atomize the paint.

2. Fluid Tip and Needle-

The fluid tip and fluid needle meter and direct the correct amount of paint into the air stream. The end of the fluid needle is tapered to a point that fits into the tip orifice from which the paint is ejected. When the end of the fluid needle is in the tip orifice, no paint can get out. When the needle is pulled back by the trigger, the tip orifice is opened and the paint can flow. Since the end of the fluid needle fits into the tip orifice, the tip and needle must be made as a matched set.

3. **Spreader Adjustment Valve-**
The spreader adjustment valve, controls the amount of air supplied to the air horns, which determine the size and shape of the spray pattern.
4. **Fluid Needle Adjustment-**
This adjustment screw, controls the movement of the fluid needle.
5. **Air Valve-**
The air valve, controls the amount of air allowed into the gun. It is operated by the trigger. All spray guns that have an air valve are said to be non-bleeder guns. They are used when the compressor unit is equipped with an automatic pressure-control switch to stop and start the compressor. All guns used for automotive refinishing are non-bleeder guns.

Spray guns that do not have an air valve are said to be bleeder-type guns. This type of gun is used when the air compressor has no control switch to start and stop the spray equipment automatically. Some air is allowed to escape through the gun at all times to keep the air pressure at a safe operating level. The bleeder-type gun is not generally suitable for automotive refinishing.

TITLE: Spray Gun Operating Principles
and Adjustments

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

1. Air Cap-

When the air-cap horn orifices are in a horizontal position, a vertical spray pattern is produced. By twisting the air cap a quarter turn so the orifices are in a vertical position, the spray pattern becomes horizontal.

2. Spreader Adjustment Valve-

When the spreader adjustment valve is fully opened, an oval spray pattern (resembling a long, thin "O") is produced. When the control valve is closed, the amount of air going to the horn orifices is reduced and the spray pattern is brought down to a small, round "O".

3. Fluid Adjustment Valve-

The fluid adjustment valve controls the amount of fluid that passes into the air stream. When a full spray pattern is desired, it is turned out until the first thread is showing. Turning the control valve in decreases the amount of paint in the mixture. When a small, round spray pattern is used, the fluid flow should be decreased accordingly.

4. The Trigger-

The air valve and fluid needle are both controlled by the trigger. When the trigger is pulled, the air valve opens before the fluid needle, to provide a sufficient supply of air at the air cap to atomize the first drop of paint.

A partly pulled trigger restricts both air and paint flow so that less paint is applied to the surface. This spray-pattern control is often used to blend paint over an area at the start or finish of a spray "pass".

A spray gun can be classified as one of two general types: siphon-feed or pressure-feed. The feed is the method by which the paint is supplied to the fluid nozzle.

OPERATING PRINCIPLES OF SIPHON-FEED SPRAY GUNS:

The fluid tip used on the siphon spray gun extends approximately 1/32 inch past the face of the air cap. When the trigger is pulled, air flows through the gun and out the center orifice surrounding the fluid

tip. A low pressure area is created directly in front of the fluid tip. Air at atmospheric pressure enters the fluid container through the opening in the lid and forces the fluid up the fluid tube and out the fluid nozzle into the low-pressure area. Air from the air cap atomizes the paint into a fine spray approximately 5/8 inch past the face of the air cap.

The size of the siphon paint container is limited to about one quart. Only very thin materials can be sprayed with the siphon spray gun. NOTE: When the vent hole in the top of the fluid container becomes clogged with paint, the air at atmospheric pressure cannot enter the fluid container and no paint will be emitted from the fluid tip.

OPERATING PRINCIPLES OF PRESSURE-FEED SPRAY GUNS:

In this system, the material is placed in a closed container which is pressurized by the air supply. The air hose is connected from the air transformer to a regulator on top of the fluid container. The regulator is adjustable and controls the pressure of the fluid in the container. The paint is forced up the fluid hose to the fluid nozzle. The amount of pressure acting on the fluid determines the rate at which the paint is supplied to the fluid nozzle.

The fluid container can be connected directly to the gun but, in most cases, the fluid container is a separate unit varying in size from two quarts to sixty gallons. The pressure-feed gun and separate container are used where large quantities of the same color are to be sprayed.

The air needed to atomize the paint at the air cap is supplied by an air hose connected from the regulator on the fluid container to the air inlet on the spray gun.

SIPHON-FEED GUNS VS PRESSURE-FEED GUNS:

With the pressure-feed spray system, the atomizing pressure and the supply of paint at the spray-gun head can be controlled separately. With the siphon spray gun, the amount of paint used depends entirely on the amount of air pressure. The siphon gun is capable of applying only 12 fluid ounces of paint per minute. With the pressure system, much greater quantities can be applied per minute.

The pressure-feed spray gun can be used effectively in any position. When the siphon gun is tipped on too great an angle with a full cup of paint, the paint will run out the vent in the lid. If the paint supply is low, the siphon gun will be starved for paint.

Both internal-mix and external-mix spray heads can be used with the pressure spray gun. However, the external-mix spray head is always used for automotive work, as it produces a much finer spray. The external-mix head only can be used with a siphon spray gun. When the external-mix head is used with the pressure-feed gun, the fluid tip is set flush with the face of the air cap. The fluid tip orifice is much smaller on the pressure gun than on the siphon gun. It is easier and faster to force paint through an opening when the pressure system is used.

TITLE: Cleaning the Spray Gun and Maintenance

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The spray gun should be cleaned immediately after the spraying operation is completed. If the paint is allowed to dry in the fluid passages and nozzle, the equipment is extremely difficult to clean.

1. Siphon-Feed Gun and Cap-

Release the gun from the cup and, with the fluid tube still in the cup, unscrew the air cap two or three turns. Hold a cloth over the air cap and pull the trigger. The air will be diverted into the fluid passages, forcing the material back into the paint container. Empty the cup.

Wash the cup, the outside of the fluid tube, and the bottom of the fluid container lid. Put a small quantity of cleaning solvent in the cup and spray it through the gun to flush out the internal passages. Spray the solvent into a rag which can then be used to clean the outside of the gun.

Remove the air cap and check that all air orifices are clean. Dry the air cap and replace it on the gun.

2. Pressure-Fed System-

Turn out the air-pressure regulating screw on the tank. Release the pressure in the tank through the relief, or safety, valve. Loosen the air cap.

Hold a rag over the air cap and pull the trigger. The material from the gun and fluid hose will be forced back into the pressure cup. Remove the paint and wash the pressure cup. Put cleaning solvent in the pressure cup and spray it through the hose and gun, flushing them out. Clean the air cap and fluid tip.

Wipe the gun and pressure them out. Clean the air cap and fluid tip.

3. Cleaning Precautions-

- a. Never soak the gun in cleaning solvent. The lubrication in the various packings will be washed away and small particles of paint will be carried into the air passages.

- b. Never use a hard, sharp instrument, such as a pin or wire, to clean the air orifices in the air cap. A slight burr will cause a distorted spray pattern. If the holes become clogged, soak the air cap in cleaning solvent and then clean the orifices with a match, a broom straw, or other soft material.
- c. Never use an alkaline solution to clean the gun. It will corrode the aluminum and die-case parts.

SPRAY GUN MAINTENANCE:

The moving spray-gun parts should be lubricated occasionally. The parts that require lubrication are:

1. Fluid-needle packing
2. Fluid-needle stem
3. Air-valve stem
4. Air-valve packing
5. Trigger bearing screw
6. Fluid-needle spring

The fluid-needle packing should be removed occasionally and softened with oil. The fluid-needle spring should be coated with a light grease.

TITLE: Using the Spray Gun
COURSE: Automotive Body and Fender

Page 1 of 3 pages
UNIT II: Spray Painting

1. Air Pressure-

The air pressure at which the spray gun is operated depends a great deal on the type and viscosity of the material to be sprayed. A fairly low air pressure is usually used for lacquer and acrylic lacquer products. The greater the viscosity of the material, the higher the air pressure must be to break up the material. The best way to determine the proper air pressure is to test the spray pattern on a discarded panel or a piece of masking paper. With the fluid adjustment valve turned so the first thread is showing, adjust the air pressure regulator to approximately 40 pounds. Hold the gun so that the air cap is six to eight inches from the test panel. Give the trigger a quick pull and then release it. The spray pattern should be in the shape of a long, thin "O" and have a uniform distribution of material over the entire area. The size and shape of the pattern are controlled by the spreader adjustment valve.

If the paint in the spray pattern has a coarse, spattered effect, the air pressure is not sufficient to completely atomize the paint. Increase the air pressure at the regulator and test the spray pattern again. Too high an air pressure will produce either a dry, sandy spray or an excessive "overspray," or a split, spray pattern. The air pressure should be adjusted so a smooth, even paint flow is obtained in the test pattern.

2. Distance from the Work-

The spray gun is held approximately six to eight inches from the work. A recommended guide to the correct gun distance is the span of a man's hand (the distance from the end of his small finger to the end of his thumb). Holding the gun too close to the surface being sprayed will cause the paint to flood, and runs will result. Holding the gun too far from the work will produce a dry, sandy spray and excessive "overspray."

Hold the gun perpendicular to the surface. When the gun is held at an angle to the surface, a spray pattern that is wet on one end and dry on the other is produced.

Move the gun in a straight, uniform stroke back and forth across the panel, keeping the gun parallel to the surface. Do not arc the spray stroke as this produces a spray that is dry on the ends and set in the center of the stroke. Each spray stroke should overlap the previous one by approximately 50 percent.

3. Triggering the Gun-

The spray stroke is started before the trigger is pulled, and the trigger is released before the end of the stroke. If the trigger is held open while starting or stopping a stroke, a build-up of paint results, producing a run.

4. Speed-

The speed of the spray gun stroke depends entirely on the amount of paint to be deposited on the surface. When the surface becomes flooded, the speed is too slow. When a dry spray results, the speed is too fast. The proper spray gun speed is chosen by observing the flow of the paint as it is deposited on the surface.

SPRAY PAINTING CONTROL: TROUBLES AND CAUSES-

1. Incorrect Spray - thin coat; rough, dry surface; no lustre.
Causes - fluid control valve not open enough; gun too far away; paint too thin; air pressure too great; stroke too fast; overlap too small.
2. Incorrect Spray - heavy coat; sags, ripples or orange peel.
Causes - air nozzle dirty; gun too close; paint too thick; air pressure low; stroke too slow; overlap too great.
3. Controlled Spray - medium coat; good flow; little orange peel and no sags.
Reason - gun clean and properly adjusted; gun distance good; paint reduction correct; air pressure correct; stroke good; overlap 50 percent; reducer or thinner correct; temperature correct.

CORRECTING AN IMPROPER SPRAY PATTERN-

A defective spray pattern can usually be traced to a partially plugged air-cap orifice or fluid tip. To check the probable cause, rotate the air cap one-half turn. If the position of the defective spray pattern changes, the trouble is being caused by the air cap. If the defective pattern does not change, the trouble is in the fluid tip or needle. Remove the defective part and clean its orifice thoroughly with thinners and a soft bristle brush.

SPRAYING PROCEDURES-

The spraying procedure is determined by the type of material with which the area is to be refinished.

Enamel products are sprayed in two coats. The first coat should be of medium-flow coverage. It is allowed to set from 10 to 30 minutes, the length of time depending on the temperature and humidity. When the first coat has become tacky, a final, full-flow coat is applied over the first coat. The paint is then either force dried or allowed to sit for six or eight hours in a temperature-controlled room to air dry. Enamel dries to a high gloss and needs no polishing or rubbing.

Lacquer and acrylic lacquer products are applied in two to six wet, single or double coats. A double coat is two coats applied one immediately after the other. The paint is then allowed to "flash off" or "set up" a few minutes, and the surface is recoated. With each successive coat, the paint is thinned down a little more to obtain a better flow. The last coat usually is mostly thinner, with very little paint. Both lacquer and acrylic materials have to be buffed, or polished, with a fine rubbing compound to bring up the final finish.

Metallics should be reduced as recommended, and a sufficient number of coats should be applied to obtain an adequate film thickness. Avoid thick, heavy, wet coats to prevent the metallic particles from flooding the surface. The metallic particles are much heavier than the paint pigment. Metallics are usually sprayed with a somewhat higher air pressure than ordinary top-coat materials, to avoid giving the surface a mottled effect.

When enamel materials are used, the complete panel must be refinished. Both lacquer and acrylic lacquer materials can be "spot sprayed" and blended into the old finish, providing the refinishing material is the same as that of the original finish. Spot spraying and single-panel refinishing are complicated by the fact that a color match is often hard to obtain.

TITLE: Air Compressors and Regulators

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The air compressor is a machine designed to pump air from the atmosphere and to compress it to a higher pressure. Compressors are driven by either an electric motor or a gas engine. The larger compressors are usually equipped with:

- a. A heavy, steel storage tank to store the compressed air.
- b. An automatic pressure switch for stopping and starting the motor at predetermined minimum and maximum pressures.
- c. A check valve to prevent the air from leaking from the tank through the compressor.
- d. A safety release valve to relieve the pressure in the tank if the automatic pressure switch fails to shut off the motor.

The volume of air a compressor can pump in a minute is given in cubic feet per minute (cfm). The pressure to which the compressor can subject the air is given in pounds per square inch (psi). Effective operation of the air equipment is dependent more upon the capacity of the compressor (cfm rating) than on the compression rating (psi).

A siphon-feed gun uses about 8.5 cfm of air under spraying pressure of 40 to 60 psi. A suitable compressor for spray painting should be capable of compressing large volumes of air to a medium pressure rather than small volumes of air to a high pressure.

TYPES OF COMPRESSORS:

There are two very different types of compressors produced. They are referred to as diaphragm-type and piston-type compressors.

The diaphragm type is a small air compressor which develops a low-volume pressure through the reciprocating action of a flexible disc, or diaphragm, that is operated by an eccentric. A compressor of this type is not usually suitable for automotive work. It provides sufficient air for use only in the home or small workshop.

The piston type is a larger air compressor which pumps through the reciprocating action of a piston in a cylinder. Air is drawn in through an intake valve as the piston moves down the cylinder. On the upward stroke, the piston compresses the air and an exhaust valve opens. The air is pushed out of the cylinder into the storage tank or air line as the piston reaches the top of the cylinder.

Piston-type compressors can be further classified as single-stage or double-stage models.

1. Single-State Compressor-

This style compressor has one or more cylinders of uniform size. The air is drawn in, compressed, and exhausted into the storage tank in one complete piston cycle.

2. Two-Stage Compressor-

This type of compressor has two or more cylinders of unequal size. The air is compressed in two separate steps. It is compressed to an intermediate pressure in the first, or larger, low-pressure cylinder, and exhausted into a connecting tube called an intercooler. From the intercooler the air enters a smaller cylinder where it is compressed to a higher pressure and then exhausted into the storage tank.

Single-stage compressors are not as efficient or economical when the air volume has to be pumped to high pressures. When pressures of 100 psi or more are involved, the two-stage unit is more efficient, runs cooler, and delivers more air for the power consumed.

COMPRESSOR MAINTENANCE:

The oil in the compressor crankcase should be checked at least once every week and changed every two or three months. The manufacturers' recommendations should be followed with regard to the type of oil to be used. The bearings in the electric motor should be oiled periodically unless they are grease packed.

The belt tension should be checked and the air intake strainer cleaned at least once a week, the frequency is dependent on dust conditions in the shop. Accumulated dust should be blown from the cooling fins.

The drain on the bottom of the storage tank should be opened at least once a week to drain out oil and water that has condensed from the air. The safety-valve lever should be lifted periodically to make sure it is functioning properly.

TITLE: Spray Booth and Respirators

Page 1 of 2 pages

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

SPRAY BOOTH:

The spray booth is a specially designed, fireproof room or enclosure, built to confine and exhaust "overspray" and explosive fumes resulting from spray painting. The exhaust fan draws the contaminated air out of the booth and replaces it by drawing fresh, clean air in through a series of filters in the booth doors. The filters remove dust particles and impurities from the air before the air enters the spray booth. Some types of filters can be blown clean and washed when they become dirty, while other must be replaced.

The spray booth lights are positioned to produce as shadowless an illumination as possible so that the painter can see the air being sprayed. The spray booth walls and floor should be kept as clean of paint as possible. Some of the many advantages of a spray booth are:

Safety-

1. When spraying is performed in a booth, there is little chance of an explosion occurring.

Quality-

2. The freshly painted area is protected from dust and dirt particles normally found in the air.

Health-

3. The paint "overspray" and fumes are less hazardous to spray-gun-operator.

If a commercial booth is not available, a room approximately 9 ft. high, 14 ft. wide, and 25 ft. long may be used. Adequate lighting to eliminate all shadows should be provided. An exhaust fan capable of maintaining air movement of 100 lineal feet per minute throughout the area is also necessary. A filtered air intake is another requirement. To prevent contamination of the newly painted vehicle, the air spray booth may be used as a drying area. In many cities fire underwriters require that automotive vehicles be painted in spray booths designed for the purpose. But even if such requirements are not in force, it always pays to use a spray booth. The initial cost is soon offset by better paint jobs and improved health of workers. There are two basic types of spray booths: (1) dry type and (2) air wash type.

Some variations of the dry type booth are used almost exclusively by auto body refinishers while the air wash type is used in production work. In the dry type spray, contaminated air is drawn through baffles or removable filters and is expelled directly outside. In the watertight-spray booth air is drawn through a series of water curtains and baffles to remove solids from overspray before it is exhausted.

Commercially constructed booths are desirable, but some auto refinishers construct their own booths by partitioning off a corner of the shop.

RESPIRATORS:

Paint fumes are toxic in nature and should not be inhaled. When spraying paint, or when working in an area where paint is being sprayed, a respirator should be worn. A respirator is a mask worn over the nose, the mouth, to prevent the inhalation of toxic pigment particles, harmful dust and vapors from various types of paints and lacquers. The hood type respirator which protects the eyes of the wearer is a popular type. The organic type respirator is equipped with replaceable cartridges that remove organic vapors by chemical absorption and any dust particles that may be present. Some respirators are designed to remove dust only, and are satisfactory only if the material being sprayed contains no toxic fumes.

TITLE: Masking Paper and Tape

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

Masking tape differs from other forms of tape such as cellophane tape because of the intended use of the tape. A general-purpose tape suitable for body working purposes should have the following characteristics:

1. It should be pressure-sensitive so as to stick on contact with a surface.
2. It should have a backing strong enough that it can be removed without tearing.
3. The tape and adhesive must be waterproof so that it will withstand water used when sanding and washing.
4. The tape should have a general adhesive that will stick to any surface usually found on a car; such as metal, wood, glass and rubber.
5. The tape must be fairly thin, so that paint will not build up excessively along the edge of the tape.
6. The adhesive must be able to withstand the blast of pressure from air and spray guns without lifting up and peeling.
7. The tape must be capable of being stretched to some extent without returning to its original size, since masking around corners is often required.
8. The tape must be flexible enough to be used under any circumstances in the shop.

In certain cases, a specialized tape may be needed for special jobs.

Masking paper is available in standard roll lengths and widths, and is designed especially for masking. Other types of paper will not work as well as masking paper, and some papers will actually allow the paint to come through onto the masked area below the paper.

Masking paper must be heavy enough to prevent penetration by lacquers, enamels and the thinners and reducers that are used with them. If these substances were to penetrate, the job underneath would obviously be ruined and would have to be repainted. Lighter surfaces might be darkened, or dark surfaces lightened if the paint penetrated the paper. Chances are the paper would also have a tendency to stick to the surface being masked if the paint were able to penetrate the paper.

The masking paper must be flexible enough to form to the contours required in masking a modern automobile. However, it must not be so thin that it will tear easily. It must be strong enough to withstand being applied around contours and corners without excessive tearing. Obviously, paper will not stretch like rubber, but it should not be as rigid as metal either.

Paper must also be fairly smooth to prevent scratching the finish underneath the paper. If paper was applied and removed causing deep scratches in the original finish, it would mean additional refinishing operations.

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TITLE: Types and Selection of Thinners
and Reducers

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The basic function of a thinner and a reducer is primarily the same: to dilute refinishing materials such as primer-surfacers and topcoats that are too thick to spray as they come in the container. Thinners are used to dilute lacquer undercoats and topcoats and reducers are used to dilute enamel undercoats and topcoats. Note: Never use a thinner in enamel products or a reducer in lacquer products.

FUNCTION:

A thinner or reducer must be properly balanced; that is, made of the right ingredients, which will provide the following results:

1. Dilute the material so that it will not only pass through the spray gun smoothly, but also atomize easily as it leaves the gun and travels to the surface being sprayed.
2. On reaching the surface, it should keep the material in solution long enough for it to flow out and level to a smooth, even surface. At the same time it must not allow the film to sag or run.
3. After #2, thinner or reducer must completely evaporate so as to leave a tough, smooth, durable film.

THINNER/REDUCER REQUIREMENTS VARY WITH SHOP CONDITIONS:

There are two very important variables which affect the spraying of materials, and unless a shop has summer-winter air conditioning, these variables must be carefully observed and compensated for by use of the right solvent. They are temperature and humidity. Of the two, temperature is the most important. Here is how they affect sprayed material.

1. Hot, dry weather produces the fastest dry time.
2. Hot, humid weather or warm, dry weather produces a fast-dry time, but slower than #1.
3. Normal weather - 70° with 45-55 relative humidity produces a normal dry time. It is slower than #2.

4. Cold, dry weather produces a slower dry time than #3.
5. Cold, wet or humid weather produces the slowest dry time of all.

SELECTING THE RIGHT THINNER/REDUCER:

The general rule in selecting a thinner or reducer: The faster drying the shop conditions, the slower drying the thinner or reducer should be.

For example:

1. In hot, dry weather, an extra-slow dry thinner/reducer is recommended.
2. For cold, wet weather, a fast-dry thinner is recommended. Charts have been prepared to provide guidance in the selection of thinners and reducers to compensate for varying shop conditions. (See your paint dealer).

THINNER/REDUCER REQUIREMENTS VARY WITH THE JOB:

To properly match an old finish, it may be necessary to spray the top-coat dry, medium or wet, particularly in matching of metallics. The right thinner or reducer can control the dryness or wetness required, as well as compensate for shop conditions. Other factors affecting wetness or dryness of spray will be discussed in more detail.

TITLE: Types of Primers

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

PRIMERS:

A primer has two basic uses. It provides a base for the topcoat and prevents rust. Primers generally are applied in several thin coats.

Primer is an undercoat used over bare metal to provide an adhesive surface for the topcoat.

PRIMER-SURFACERS:

Just as the name implies, a primer-surfacer acts like a primer; that is, it makes the topcoat adhere better, and protects metal from corroding. But it does one more thing...it will fill small scratches, pinholes, nicks, etc. When applied, primer-surfacers produce a thick film and must be sanded smooth before the topcoats are applied. Primer-surfacers are applied to either bare metal or old finishes that have been sanded.

We can define a primer-surfacer as a primer that also fills surface flaws in the surface (substrate).

TITLE: Types of Finish Paints

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UNIT II: Spray Painting

DIFFERENT TYPES OF FINISHES

There are two basic types of finishes used on automobiles, lacquers and enamels. Both are very durable and flexible. Let's look at the differences:

1. Lacquer Finishes. Lacquers dry very fast and generally have to be compounded or rubbed with an abrasive or polish to make them look smooth and satiny.
2. Enamel Finishes. Enamels are somewhat slower drying. This means that there is a greater chance to mar their smooth looks. Dirt and dust in the atmosphere will stick to an enamel finish before it is dry. Enamel dries with a gloss and does not require rubbing or polishing. However, it may have a slight texture, known as orange peel.

Modern lacquers and enamels are also used on furniture, file cabinets, refrigerators, etc.

BRIEF HISTORY OF FINISHES

Before 1924, all automobiles were finished by brushing on coat after coat of a mixture of lampblack or color (pigment) and varnish. Each coat had to dry, then be rubbed with pumice and water. Such painting methods would take nearly a month for each car. That was bad enough, but by the end of a year, the finish was generally dull and badly cracked.

In 1924, a new type of finish, nitrocellulose lacquer, was produced for automotive refinishing. The new material quickly replaced the old method of finishing. Nitrocellulose lacquer was durable, and so fast drying that it broke the bottleneck in auto production. A car could be completely finished in hours, where it used to take days. This was due not only to its drying quickly, but also for the first time, a finish could be applied with a spray gun instead of with a paint brush.

In the early 1930's alkyd enamel was produced and introduced to the automotive market. Since it was an extremely tough finish and required no compounding, it was especially suitable for trucks as well as automobiles.

Year after year these two products were improved. In the late 1950's, a third auto finish, acrylic lacquer replaced nitrocellulose lacquers due to its durability. In 1963, acrylic enamels were introduced.

So today, we find all car manufacturers using either acrylic lacquers or enamels. Both lacquers and enamels are baked in huge ovens to shorten the dry-time.

It is important that you know what type of finish each manufacturer used, as there are slightly different methods required for repainting them.

At this time all General Motors cars are finished in acrylic lacquer. Cars made by American Motors, Chrysler Corporation and Ford Motor Company are finished in acrylic enamel by the manufacturer.

METALLICS

Both lacquer and enamel finishes come in either solid colors like black, white, or yellow, or they come in what are call metallics or metallic finishes. The difference between the two is this: Metallics have pigment (color) plus metallic flakes, which create a different appearance. Solid colors generally look the same no matter from what direction you see them, whereas metallics seem to change in shade of color as you see them from different angles. Sometimes you can see the light reflecting from the metallic flakes giving it a jewel-like appearance. Thus, a metallic finish is not only a color, but also a color effect.

If this is all new to you, start looking at cars carefully to see if you can tell the difference between a solid color and a metallic. Black and white are solid colors; so are yellow and cream. How about red? It may be either. Medium greens, blue-greens and blues are often metallic, but may also be solid.

Also, see if you can tell the difference between an enamel and a lacquer. Get in the habit of recognizing these types of finishes. Sometimes it is very hard to tell the difference between the two, particularly if the car has been repainted.

FINISHES USED IN THE PAINT AND BODY SHOP

You will remember, we talked about the finishes used by car manufacturers, acrylic lacquers and acrylic enamels, which can be in either solid colors or in metallic color effects. Now, we will discuss the finishes which you will use as a painter in the refinish shop.

There is very little difference between the acrylic lacquer used in a paint and body shop and acrylic lacquer used by a car manufacturer. Lacquers used in the shop may be a little slower drying. The reason for this is the body shop usually does not use bake ovens for force drying of lacquers. Therefore, the refinish shop needs to use a faster drying thinner than the car manufacturer.

The difference between enamel finishes used by car manufacturers and those used in a refinish shop is considerable. One of the big problems with an acrylic enamel such as a car maker uses is that it must be baked in an oven at high temperatures. Not many shops have baking ovens, and high-temperature baking might damage wire, glass, upholstery, etc. Therefore, shops prefer an easy-to-apply, durable enamel which will air dry without baking, or baked at low temperatures. This is one of the reasons enamel is by far the most popular shop paint on the market.

WHAT GOES INTO A CAN OF PAINT?

1. Topcoat

Let's start with the pigment. This is what gives the paint its color and the ability to cover or hide what's underneath. A common pigment is lampblack. If you've ever cleaned a kerosene lamp or an oil burner, you've had to remove lampblack...a slightly oily, extremely black pigment. As mentioned before, metallics also have metal flakes.

Now the pigment has to have something to hold it in liquid form, to make it durable, and to make it stick to the surface. This something is called a binder. Any clear finish is almost entirely binder.

The third ingredient in a can of paint is solvent called thinner when used in lacquers or reducer when used in enamels. These solvents make the pigment and binder thin enough to apply. It makes the solution more fluid...less thick.

When the paint is applied, the thinner or reducer evaporates completely. The binder and pigment then harden into a paint film.

2. Undercoat

You may remember, we said that undercoats are used to provide a smooth base for topcoats. They, too, contain special pigments and special binders, as well as a solvent, that promote adhesion and resist rust and corrosion. Undercoats also make topcoats adhere (grip the surface).

TITLE: Types and Uses of Solvents
and Cleaners

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

TYPES

USES

- | | |
|---------------------------------|--|
| 1. Lacquer Thinner | Used in topcoats and undercoats to dilute materials to spray consistency suitable for specific shop conditions. |
| 2. Enamel Reducer | Used the same as #1; also is used as a cleaner. |
| 3. Lacquer Solvent Remover | To featheredge damaged areas of original lacquer topcoats, also for completely removing lacquer topcoats from panels. |
| 4. Wax, Grease, and Tar Remover | To remove silicone, tar, wax, polish, grease, weathered finish from old lacquer and enamel finishes. This will dissolve the above material so they can be wiped off. |
| 5. Water | Used to dissolve foreign matter and clean surfaces prior to sanding, polishing, etc. |
| 6. Metal Conditioner | Used as a metal cleaner for ferrous and aluminum metals prior to finishing. |
| 7. Gun and Equipment Cleaner | Used for cleaning spray guns and other equipment. |

TITLE: Types and Uses of Sealers
COURSE: Automotive Body and Fender

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UNIT II: Spray Painting

Types	Uses
1. Enamel	Used under Enamel Topcoat
2. Lacquer	Used under Lacquer Topcoat
3. Bleederseal	To seal a bleeding color
4. Universal	Used under Enamel or Lacquer Topcoat
5. Pre-Mixed	No thinning required-used under Enamel or Lacquer Topcoat

USES

One of the problems in painting over various surfaces is that some are more porous than others. If you have ever painted around your home, you may have noticed how paint sinks into some areas of plaster and wood more than in others. This same problem also occurs with substrates (surfaces to be painted). To prevent this sinking-in of the topcoats, sealers are used to "hold out" the topcoat.

As you will learn later in this text, you may repaint an area or even the whole car with a finish that is different from the old finish; such as, an alkyd enamel over an acrylic lacquer. To insure maximum adhesion, a sealer coat is used between these finishes. It may be pigmented or it may be clear. Also, if there is any repair area in which a primer-surfacer has been used, there may be a difference of "hold out" between the old finish and the primer-surfacer. This condition can be corrected by applying a sealer before topcoating. Later, you will learn that sanding of the old finish and areas to be repaired is required. Sanding causes scratches to appear and these might show through the new topcoat. A sealer coat applied before the topcoat will prevent this show-through.

We can say that sealers are used to provide uniform "hold" of the topcoat; to provide adhesion between the old finish and the new; and to prevent sand-scratches showing in the new finish.

Sealers are only sanded to remove nibs (specks of dirt). They are not used over bare metal.

TITLE: Types and Uses of Rubbing Compounds

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

Rubbing compounds are much like paste and liquid cleaners used before waxing a car. Whether these rubbing compounds come in paste or liquid form, they contain an abrasive such as pumice which levels the top of the finish, making it smooth and lustrous. These compounds are available in various cutting strengths both for hand compounding or machine compounding.

Generally, compounds with coarse particles of pumice are called rubbing compound. If the particles of pumice are fine, they are referred to as polishing compounds.

Actually, a rubbing compound works two ways. When it is first used, the pumice particles cut and smooth the surface being compounded. This action breaks the pumice into smaller particles so that it then works as a polish.

Three uses of rubbing compounds are:

1. To eliminate fine sandscratches around a repair area.
2. To compound an acrylic enamel finish to be spot repaired with acrylic lacquer. Compounding the old finish knocks off the lustre of the top of the texture or orange peel, thus providing "tooth" for better adhesion.
3. To smooth and bring out the gloss of lacquer topcoats.

Small areas or blended edges are best done by hand. On large areas, machine compounding is recommended. Note: However, care must be taken when machine compounding not to cut through styling edges. To avoid cutting through, remove the tape and compound the edge by hand, just enough to produce a smooth finish. Keep in mind styling edges usually retain less paint than flat surfaces and should receive only minimum compounding.

POLISHERS

Compounding or polishing is generally done with a special polisher which is lighter in weight than a disc sander and has a lower r.p.m. (revolutions per minute). Compounding pads are used for compounding, and wool bonnets for polishing. When polishing or compounding, care must be taken to keep the polisher on the move so that it won't cut through the finish.

HAND COMPOUNDING

Fold a soft cloth (lint free) into a thick pad or roll into a ball and apply a small amount of compound to it. Rub area to be compounded in straight back and forth strokes using medium to hard pressure until desired smoothness is reached.

MACHINE COMPOUNDING

Apply machine compound evenly over a small area, preferably with a medium to coarse bristled paint brush or a squeeze bottle. Then compound with a compounding pad on a machine polisher. Do not try to compound too large an area at one time as the rubbing compound may dry out.

When the compounding is finished, replace the compounding pad with a polishing pad or lamb's wool bonnet and polish.

When using a machine polisher, do not apply much pressure, and keep the polisher moving. Otherwise, you may cut through the topcoats to the undercoat. Hand the polisher with care.

The primary advantages of machine rubbing compounds are the proper cutting action and the non-clogging of the compounding pad.

How do you know when compounding is complete? It depends on the job. Compounding an original acrylic enamel finish for spot repair will actually dull the finish slightly.

Sandscratches around a featheredge should be compounded until they are eliminated.

Compound a lacquer topcoat until the final polishing produces a satisfactory lustre completely smooth and free of defects.

Do not compound a lacquer topcoat until it is thoroughly dry. If possible, wait until the next day.

Hand compounding requires lots of "elbow grease". Any compounding is time consuming. One of the ways to keep compounding of lacquer topcoats to a minimum is to apply the finish as wet as possible without sags or runs.

INFORMATION SHEET
IL-2-16

TITLE: Purposes and Uses of Paint
Strainers

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

Straining paint material by pouring into a spray cup, is used to control heavy pigment and dirt and grit from the topcoat material. Strainers are cardboard funnels with a cotton mesh.

TITLE: Types and Uses of Putty
COURSE: Automotive Body and Fender

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UNIT II: Spray Painting

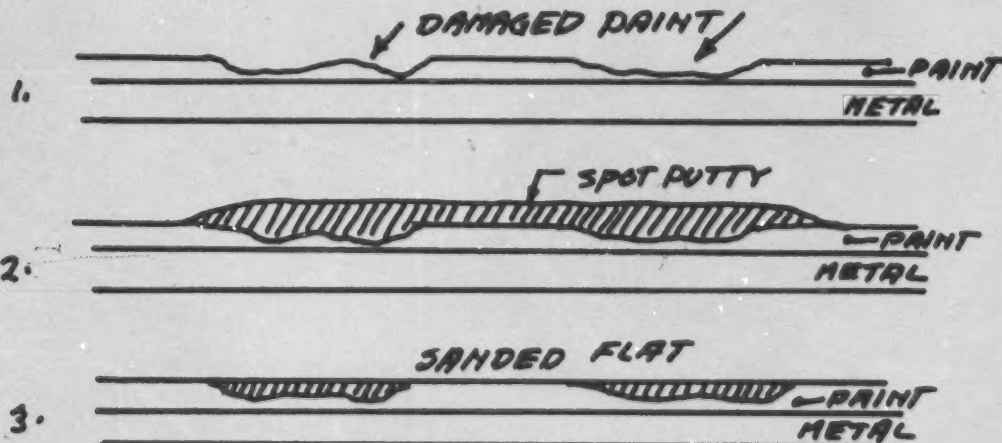
TYPE

Lacquer Type - fast dry universal
Enamel Type - slower dry universal

APPLYING AND SANDING SPOT OR GAAZING PUTTY

Automotive putties fill in large imperfections that primer-surfaces can not handle and that are too small for body work. Basically, there are two types: glazing putty to fill in sand scratches and filing marks and spot putty which contains more pigment and is used to fill in deeper nicks, scratches and marks made by coarse grinding. Putties should not be used over 1/8" large areas and only thicker must be applied in thin layers, using a squeeze or flexible putty knife. It must be worked quickly to prevent the solvents from evaporating and causing the putty to roll or ball up and become difficult to handle. Putty should never be used as a substitute for metal work. Remove excessive putty with squeeze to simplify sanding.

After the putty properly dries (one hour to overnite) sanding then should be done first with #80 paper using a block or a flat sander and sanded until smooth. It may be necessary to refill the low areas. Do not put putty over bare metal, reprime if necessary. After the putty is sanded with #80 paper it is then sanded with #320 paper and water, just enough to remove scratches left by the #80 paper. Spray two or three coats of primer-surfacer, let dry, sand with #320 and spray four or five coats of primer-surfacer it should be ready for final sanding and color coating.



TITLE: Types, Purposes, Uses and Storage
of Reducers and Thinners

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The chart below is a guide to the types, purposes and uses of reducers and thinners.

THINNER/REDUCER GUIDE

LACQUER THINNERS		ENAMEL REDUCERS	
Slow	Maximum flow and blush resistance. Very slow evaporating. Recommended for lacquer topcoats only. Excellent for mist coating.	Slow	Provide maximum flow out. Ideal for hot, dry weather. For enamel topcoats.
Slow	Very good flow out and blush resistance. For lacquer topcoats only. Slow evaporating.	Slow	Very good flow out. Slow evaporating. Recommended for reducing acrylic enamel under normal shop conditions.
Slow Re-tarder	A very rich slow-evaporating solvent for adding to topcoats or mist coats to improve flow, gloss and resistance to blushing.	Slow	For brush application of enamels.
Medium	Average flow out and blush resistance. Normal evaporating. Recommended for lacquer primer-surfaces.	Medium "Vari-Temp"	Average flow out and evaporating time. For normal weather conditions
Fast	Fast dry, economical thinner for topcoats and undercoats.	Fast	Fast evaporating. For enamel topcoats and synthetic undercoats. Also ideal final clean-up wash.
Fast	General purpose thinner for topcoats, very fast dry.	Fast	Very fast dry. For cold, damp weather.
		Fast	For use with enamel undercoats. Excellent for final clean-up.
		"Act-vator"	Use only with a Wash Primer.
		Baking Reducer	Used as an additive when force drying enamel topcoats. Also can be used as a wrinkling inhibitor in very hot weather.

STORAGE - FLAMMABLE LIQUIDS AND FINISHING SUPPLIES

The storage of flammable liquids such as gasoline, thinners, bentine and other liquids present many problems from the standpoint of convenience, fire control and prevention, health of students, and explosions. The storage of such materials can be very hazardous, troublesome and dangerous unless flammable liquid storage areas are carefully planned and provisions are made to safely care for the various types of flammable materials.

1. Flammable liquids should be stored in approved safety-type containers and then kept in fireproof cabinets or rooms.
2. Finishing supplies should be stored in fireproof metal cabinets.
3. All sources of ignition should be removed from the areas where flammable liquids are stored.
4. Gasoline used in the shop should be stored in a one-gallon safety can approved by the Underwriters Code and painted red. Bulk storage of gasoline should be in underground containers located away from the main building.
5. Containers used for flammable liquids should be clearly labeled.
6. Cabinets used for the storage of flammable liquids should not be located near the exits of the shop or building.
7. Areas used for the storage of flammable liquids should be well ventilated, cool, clean and orderly.
8. Flammable liquids and other substances should not be stored with compressed gases.

TITLE: Principles of Color Matching

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

COLOR MATCHING

One of the most critical steps in the topcoat operation is to produce a perfect match of a spot or a panel repair to the original finish.

Actually, a mismatch in a panel repair will usually show up more than a mismatch of a spot repair. Here's why. A panel repair is cut off abruptly; that is, it has an edge. For example, if you are repainting an entire door, any mismatch will be right next to the adjoining panels and will show a sharp contrast.

On the other hand, a spot repair is performed by blending the repair into the surrounding area. In spot repairing, the first coat is applied on the immediate repair area. Subsequent coats should be extended beyond this area slightly. Finally, a mist coat or a blend coat, extending beyond the color coats if applied. Thus, if there is a slight mismatch, the blend coat and last color coat will allow enough show-through of the old finish to make the mismatch a gradual one.

MATCHING METALLIC FINISHES

Generally, non-metallic, pigmented colors properly prepared, thinned and sprayed will provide a good color match.

However, matching of metallic finishes is probably the most skillful operation the painter has to perform. And the most important, too, because there are more cars on the road with metallic finishes than solid colors, which means there are more metallic repairs to be made.

What is a metallic finish? Both lacquer and enamel finishes come in either solid colors black, white or yellow or metallics or metallic finishes, such as blue, green or gold. The difference between a solid color finish and metallic finish is that the metallic contains small metallic flakes. The final position of these flakes in the sprayed-out finish will have considerable effect on the color match. Furthermore, a metallic finish will look different when viewed from various angles... from the side, head on, or from the top. For this reason, metallics are often called "color effects" rather than colors.

WHY METALLIC COLOR MATCHES ARE MORE DIFFICULT

Although the material in the can is a perfect match to the car maker's standards, it can still end up as a poor match if not properly applied.

There are two basic causes for this:

1. Failure to thoroughly stir the paint. It must be thoroughly stirred both before and after thinning. Any pigment or flake left in the bottom of the can or spray cup will change the sprayed-out color.
2. Failure to apply at the same degree of wetness as the original finish. If the original finish was sprayed wet, and the repair is sprayed medium or dry, the repair will be lighter in color. Reasons why:
 - a. When a wet coat is sprayed, the metallic flakes have time to position themselves more deeply in the finish before it flashes. This will produce a darker, stronger color effect.
 - b. When a dry coat is sprayed, the metallic flakes are trapped nearer the surface of the rapidly drying film. This will produce a lighter, more metallic looking finish.

At present, most new cars with metallic finishes are sprayed wet.

Gun adjustments, spray techniques and proper thinners are all means of controlling the wetness of the spray material.

If after you spray a couple of coats over the repair area you find the repair is too light and metallic looking, darkening of the shade is attained by spraying several wet coats. This can be done by using one or more of the following adjustments to provide a wetter spray.

1. Open fluid feed valve more.
2. Reduce size of pattern.
3. Decrease gun distance.
4. Slow down stroke.
5. Allow less flash time between coats.

When the repair is too dark, then follow with several coats that are lighter and more metallic in appearance. Reverse the adjustments or techniques given above using one or more of the following:

1. Close fluid valve slightly.
2. Increase the size of the pattern.
3. Increase gun distance.
4. Speed up stroke.
5. Increase flash time between coats.

If the above techniques do not provide the desired degree of wetness or dryness, then a thinner or reducer with a different evaporation rate can be used.

In making a metallic repair, it may be difficult to foresee whether the match will be accurate. In this situation, it is helpful prior to making the repair to spray out a small, hard-finished panel and hold it against the original finish to check the match.

To summarize:

1. Stir thoroughly. Be sure all solids are thoroughly mixed with a paint paddle...(Don't leave solids on the bottom of the can.)
2. Thin with a thinner/reducer that's right for the shop temperature.
3. Examine original finish from several angles to determine how best to apply matching color. (wet or dry)
4. Set correct pressure at the gun.
5. Make a test panel and if the match is not right, adjust technique to arrive at a suitable match.
6. When the test panel match is satisfactory--use the same technique for the repair.
7. Apply a mist coat to melt overspray and help leveling.

TITLE: Purposes and Uses of Sanding
Blocks and Squeegee

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

This is a simple back and forth scrubbing action with the sandpaper flat against the surface. An important point to remember, on flat surfaces, don't sand without backing up the paper with a sanding block or pad. When sanding without a block, all the pressure is from the finger tips only. The area between the finger tips will not receive the same cutting or sanding action as the area where the fingers contact the surface. Flat surfaces can be sanded with a flat hard rubber sanding block. However, for sanding curves and edges a sponge rubber pad should be used for sandpaper backing, as it will follow the contour or curves of the surface more easily.

There are two methods of hand sanding, dry sanding and wet sanding.

1. Dry Sanding

This is done as described under hand sanding. One of the big problems with dry sanding is that the paper tends to clog from paint or metal dust. Tapping the paper will remove some of the dust. However, zinc stearate paper is now being used by many shops, as it tends to prevent clogging.

2. Wet Sanding

Wet sanding solves the problem of paper clogging. It is basically the same action as dry sanding except you need water, a sponge and a squeegee. When sanding by hand a block or pad should be used.

The paper is dipped in the water or the surface is wet with a sponge and the sanding operation carried out just as in dry sanding. When the paper begins to slide easily over the surface, it is no longer cutting because the grit has become filled with paint particles or sludge. Rinsing the paper in water will remove the paint or dust from the sandpaper and sponging the area which you are sanding will clean the particles from the surface. Then the sandpaper will cut into the surface again. You can tell how well the paper is cutting by the amount of drag or resistance you feel as it moves across the surface.

Periodically, you should carefully check the surface. Sponge off, then wipe the area with the edge of a squeegee. This removes all excess water so that you can see the surface clearly and check your sanding progress.

Most shop owners agree that using the same grit or degree of coarseness, wet sanding will give a smoother job. Yet, some feel that the use of water slows down the operation despite the above mentioned advantages, because of the clean-up operation.

You should try both methods until you have satisfied yourself which is better for you. However, on some jobs, which will be discussed later, wet sanding is recommended.

TITLE: Grits, Sizes, Types and Purpose
of Sandpaper

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

There is some difference in opinion among auto body men regarding the use of specific grits for the various phases in auto body reconditioning. Some favor coarse grits, while others insist on using fine grits. It must be remembered that coarse grits, while cutting faster also produce deeper scratches which have to be removed before the actual painting; otherwise the scratches will show through the primer and color coats.

The accompanying tables show recommendations made by abrasive manufacturers for grits to be used in preparing the metal for painting, and also those to be used during the painting operation.

TABLE OF ABRASIVE GRITS
USED IN METAL PREPARATION

REFINISHING OPERATION	TYPE OF ABRASIVE	RECOMMENDED GRIT	
		WET	DRY
Featheredging primary	Open coat	..	80 or 100
Featheredging final	Closed coat	220 or 320	220 or 320
	Open coat	..	220 or 320
Sanding primer coat	Closed coat	280 or 320	..
	Open coat	..	280 or 320

REPAINT SANDING RECOMMENDATIONS
RECIPROCATING

TYPE OF FINISH	TYPE OF WORK	HAND SANDING		SANDER		DISK SANDER	
		WET	DRY	WET	DRY	WET	DRY
Enamel	Quality	320	240	320	280	...	240
	Fast	280	220	280	220	...	220
Nitro Cellulose Lacquer	Quality	360	320	400	400	...	280
	Fast	320	280	320	280	...	220
Acrylic Lacquer	Quality	400	320	500	400	...	320
Acrylic Enamel	Quality	400	360	...	400	...	320
	Fast	360	320	...	360	...	320

TITLE: Fish-Eye Elimination and
Anti-Wrinkle Agents

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UNIT II: Spray Painting

Fish-eyes are caused by painting over silicone. There are specially formulated cleaners for removing silicone bearing polishes and waxes. It cleans the surface of all other greases and contaminating substances in the same operation. Another method to eliminate "fish-eyes" is to add Fish-eye Preventer to the enamel, lacquer or acrylic being sprayed. This does not remove the silicone but prevents its effects from showing in the finished coat.

Wrinkling is caused by an under reduction or air pressure too low causing excessive film thickness, excessive coats, fast reducers creating overloading, surface drying trapping solvents, fresh film subject to heat too soon. To remedy wrinkling break open top surface by sanding and allow to dry thoroughly, then sand completely and refinish.

TITLE: Glossary of Refinishing Terms

Page 1 of 5 pages

COURSE: Automotive Body and Fender

UNIT II: Spray Painting

ACRYLIC: A crystal-clear chemical compound used in lacquers and enamels. Provides excellent durability, color and gloss retention.

ADHESION: Ability of one substance to stick to another.

AIR DRY: Where a finish reaches ultimate hardness under normal atmospheric conditions.

ALKYD: A widely-used vehicle for paint.

ATOMIZATION: Breaking up of paint into tiny droplets. Forming a fog or mist from a liquid. This is done with a spray gun.

BINDER: That part of a paint which holds the pigment particles together, forms a film and imparts certain properties to the paint. Part of the solids.

BLEEDING: An old color which comes through and colors a fresh topcoat. Used to occur when maroons were topcoated.

BLISTERING: Bubbles which form on a paint film.

BLUSHING: A topcoat with a milky or misty appearance.

BODY OR VISCOSITY: The degree of thickness of a liquid. Heavy bodied or high viscosity describes a thick liquid.

BRONZING: The formation of a metallic-appearing haze on a paint film.

BUILD: The amount of paint film deposited. The depth or thickness of the film is measured in mills (thousandths of an inch.)

CHALKING: Formation on a finish caused by a pigmented powder no longer held by the binder. The finish has a dull appearance.

CHECK: A small crack usually 1/16 to 1/8 of an inch in size and unconnected.

CHIPPING: Where small segments of topcoat break away from the finish.

CLEAR: A finish having no pigments (color) or transparent pigments only.

COALESCENCE: Fusion or flowing together, as atomized paint droplets.

COAT, DOUBLE: Two single coats, one followed by the other with little or no flash time.

- COAT, SINGLE:** A coat produced by two passes of the spray gun, one pass overlapping the other in half-steps.
- COMPATIBILITY:** The ability to two or more materials to work or mix with each other. For example, thinner and paint are compatible, oil and water are not as they will not mix.
- CONTAMINANTS:** Anything on the surface to be painted that would adversely affect the finish, such as tar, grease, oil, tree sap or wax.
- CORROSION:** Break-down of a metal caused by chemical reaction, such as rust on steel, caused by moisture.
- COVERAGE:** The amount of surface which a given amount of paint will cover.
- CRACKING:** The formation of cracks in a paint film.
- CRATERING:** Formation of holes in the film where paint fails to cover due to surface contamination.
- CRAZING:** A break-down of the finish in the form of small cracks in all directions. Similar to "crow's feet."
- CURING:** To complete a final drying stage where a paint reaches its full strength through a chemical change. Also applied to drying of plastic fillers.
- DECALOMANIA:** A picture, design or lettering transferred to a surface such as a truck body, generally made of an enamel film.
- DRIER:** A catalyst added to a paint to speed up the cure or drying time.
- DRY-SPRAY:** A coat of color where the sprayed coat is short of liquid material, particularly the thinner or reducer
- DURABILITY:** Length of life of a paint film.
- ENAMEL:** A type of finish which not only dries by evaporation of solvents but also cures through a chemical change.
- EVAPORATION:** To change from a liquid to a gas. Solvents, for example, evaporate from a paint film by changing from a liquid to a gas.
- FANNING:** Use of pressurized air through spray gun or dusting gun to speed up the drying time of a finish. This practice is not recommended.
- FEATHEREDGE:** A tapered paint edge going from base metal to topcoat.
- FINISH:** A protective coating, usually of paint, designed to beautify and protect a surface.

- FISH EYES:** Small craters that form in a finished paint film.
- FLASH:** The first stage of drying where some of the solvents evaporate, which dulls the finish from a high gloss to a low or normal gloss.
- FLASH TIME:** The time required for a finish to flash.
- FLOW:** The ability for droplets of sprayed paint to merge or melt together to form a smooth film.
- FORCE DRY:** Accelerated drying of finishes by means of heat.
- GLOSS:** The "sheen" of a paint film, or its ability to reflect the light.
- HARDNESS:** That quality of a dry paint film which gives the film resistance to surface damage of deformation.
- HIDING:** The degree to which a paint obscures the surface to which it is applied.
- HOLD OUT:** The ability of a surface to keep the topcoat from sinking in.
- HUMIDITY:** Amount of water vapor in the air. Relative humidity is the ratio of the amount of water vapor in the air to the total possible amount which could be in the air at a given temperature.
- LACQUER:** A type of paint in which the binder is made up of solid particles. The film is formed by evaporation without chemical action.
- MASKING:** The covering of areas not to be painted.
- METAL CONDITIONER:** An acid-type cleaner which removes rust and corrosion from bare metal and etches it for better adhesion. It will also form a film which inhibits further corrosion.
- METALLICS:** A class of finishes or paints which include metallic flakes in addition to the pigments.
- MIST COAT:** A coat of rich, slow evaporating thinner with little or no color added.
- MOTTLING:** A painting problem with metallics where the coat is so wet that the metal flakes float together to form a spotty or dappled effect.
- ORANGE PEEL:** A texture in a finish caused by the droplets failing to completely flow together.
- OVERSPRAY:** An overlap of dry spray gun particles on areas where they are not wanted.

PAINT REMOVER: A chemical which breaks down an old finish by liquefying it.

PIGMENT: A solid that will not dissolve in liquid. It is ground and mixed with a vehicle to provide color in paint.

PINHOLING: Small holes that form in the topcoat or undercoat.

PRIMER: A base or undercoat next to the metal or substrate which improves adhesion of the topcoat.

PRIMER-SURFACER: A high-solids primer that fills small imperfections in the substrate. Usually must be sanded before applying topcoat.

PUTTY: A heavy-bodied material used to fill flaws that are too large to be filled by the primer-surfacer.

REDUCER: A solvent used to reduce or thin enamels.

RESPIRATOR: A device worn over the nose and mouth to filter particles out of the air being breathed.

REAARDER: A very rich, slow-drying solvent that slows down the evaporation rate. Normally used as an additive.

RUBBING or POLISHING COMPOUND: A fine abrasive that smoothes and polishes the finished paint film.

RUST-INHIBITING: Being able to slow down rusting or oxidation of metals.

SAGS: Runs in a paint film caused by excessive paint.

SANDER: A power tool designed to sand finishes and featheredge. It may be air or electric powered, and may be orbital, straight or disc.

SANDING BLOCK: A hard, flexible block used to provide a smooth backing for hand sanding.

SANDSCRATCH SWELLING: The swelling of sandscratches in the old topcoat caused by application of solvents in a new topcoat.

SEALER: An intercoat between the primer and topcoat or old topcoat. It promotes adhesion and holdout between two dissimilar finishes and prevents sandscratch swelling.

SETTLING: A condition caused by solids in the paint container falling to the bottom of the container.

SILICONE: An ingredient in waxes and polishes which makes them sleek and shiny. It is a primary cause of fisheyes in a finish topcoat.

- SKINNING:** A condition caused by formation of a film on the top of the liquid in a paint can. It can also be a condition caused by the formation of a film on heavy or thick topcoats before the solvents in the underlayer of the topcoat have evaporated.
- SOLIDS:** The percentage, on a weight basis, of solid materials in a paint after the solvents have evaporated.
- SOLVENT:** A liquid that dissolves, dilutes or liquefies another liquid or solid. The classification includes reducers, thinners and cleaners.
- SOLVENT POPPING:** Bubbles which form on a paint film.
- SPRAY GUN:** A tool or instrument which atomizes liquids.
- SQUEEGEE:** A small, rectangular, rubber block used to wipe off wet sanded areas or to apply putty.
- SUBSTRATE:** The surface of material to be painted. It may be an old finish or bare metal area.
- TACK RAG:** A cloth saturated with diluted varnish to make it tacky or sticky so it will pick up small particles of dust and dirt.
- THINNER:** A solvent used to thin or dilute lacquers.
- TWO-TONE:** A paint job using two different colors; to apply two different colors on the same paint job.
- VEHICLE:** All of the paint except the pigment. This category includes solvents, dilutents, resins, gums, driers, etc.
- WATER SPOTTING:** A condition occurring when water droplets mar the finish before it has cured. Washing a car in the sun may also cause water spots on the finish.
- WET SPOTS:** Areas where the paint fails to dry and adhere uniformly. Generally caused by grease spots, finger marks and oil spots.
- WRINKLING:** The skinning of a coat of thick or heavy paint before the underpart of the film has properly dried.

TITLE: Stripes and Decals

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

Two types of transfers or decals are available for repairing the wood grain transfers on exterior steel body panels. For this reason, it is necessary to determine which type of transfer is used on the vehicle so that the repaired panel will match adjacent panels. The two transfer films can be identified as follows:

The pressure sensitive wood grain transfer film has a low gloss finish and a realistic wood grain effect. It can also be identified by the absence of a brown basecoat around the transfer film when the trim rails are removed.

The Di-Noc wood grain transfer film has a high gloss because of the clear enamel finish coat applied over the transfer film. It can also be identified by a brown base coat visible around the transfer film when the trim rails are removed.

There are two types of accent stripes used; those that are made with vinyl tape, and those that are painted with striping lacquer. In some instances, it may be necessary to slightly heat the strip material to make the adhesive hold.

There are two methods you can use to repair or replace paint pin stripes; the free hand method and the masking tape method.

Stripes using masking tape. This procedure requires the aligning of two pieces of masking tape parallel with a space between them representing the desired strip width.

TITLE: Spray-On Immitation Vinyl Top

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COURSE: Automotive Body and Fender

UNIT II: Spray Painting

The vinyl roof is applied in three steps: the preparation coat, the texture coat and the final coat. The texture coat is applied unreduced - straight out of the can. All of these coats must be applied with a pressure feed gun because of the heaviness of vinyl paint.

The texture will vary with the spray technique used. Generally, lower pressure and the further the gun is held away, the deeper and coarser the texture.

If you have never sprayed a texture vinyl finish, it is recommended that some test panels be sprayed first at varying air pressures and gun distances. Then select the air pressure and gun distance which produces a suitable texture.

When using a pressure gun never exceed the pressure set by the manufacturer.

The seam on the vinyl top is imitated by the use of a special tape. The seam tapes vary by manufacturer.

TITLE: Relays and Switches
COURSE: Automotive Body and Fender

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UNIT III: Electricity

Relays - The cutout relay (or circuit breaker) consists of two windings assembled around a core and a flat steel armature mounted on a hinge above the core. A contact point on the armature is placed just above a stationary point that is connected to the battery. When the generator is not operating a spring on the armature holds the two points apart. This keeps the circuit between the generator and the battery open. The two windings consist of a current, or series, winding of a few turns of heavy wire and a voltage, or shunt, winding of many turns of fine wire. When the generator begins to operate, its voltage builds up, imposing voltage on the two windings. This creates a magnetic field that attracts the flat Steel armature. Increasing generator voltage increases the magnetic attraction until operating voltage is reached.

Switches - Various types of switches are employed on automotive vehicles. The various switches and typical circuits in which they are connected are presented here:

- a. Head Light Switch - The light switch generally has three positions to control the lights: 1) Off position - Knob all the way in cuts off all the lights controlled by the switch. 2) Parking position - Knob pulled out to first notch turns on the parking and tail lights and, when employed, a separately mounted license plate light. 3) Driving position - Knob pulled all the way out turns the parking lights off and the head lights on, while the other lights remain as in the parking position. Depending upon the position of the dimmer switch connected in the head light circuit, the headlights will either be on the upper or lower driving beam.
- b. Dimmer Switch - When the head lights are turned on, the driver can change from the upper to the lower head light beam, depending upon traffic and road conditions, by operating a dimmer switch mounted on the left side of the floor board, or on the steering column assembly. The dimmer switch opens and closes the circuits to the upper and lower filaments in the sealed beam units, raising and lowering the head light beams with each successive operation of the foot switch.
- c. Stop Light Switch - The switch is actuated by the hydraulic pressure created in the brake lines when the brake pedal is depressed. The pressure of the fluid forces a bronze contact diaphragm to complete the circuit at the contacts. The stop light switch is mounted on the master cylinder on some vehicles. On others, the switch is mounted on a T connection in the brake lines.

- d. Directional Signal Light Switch - Directional signal lights are controlled by a manually operated switch mounted under the steering wheel. When the switch lever is moved to indicate a turn, a flasher switch causes the front and rear signal lights to flash on and off on the side of the car nearest to the direction of turn, at a rate of about ninety times per minute. While the signal lights are flashing, a signal indicator bulb on the instrument panel also flashes, producing a small arrow of light to indicate to the driver the direction for which the signal has been set.
- e. Toggle Switch - Toggle switches are employed to manually turn on and off the instrument lights, spot light, and the interior lights.
- f. Spring-Loaded Jamb Switches - Spring-loaded jamb switches are employed to automatically turn on and off the dome, pillar, trunk, glove compartment, and courtesy lights in the interior of the vehicle. The switches are mounted in a hole drilled in the door jamb, and are operated by the opening and closing of the doors. The interior lights usually have a toggle switch connected in parallel in the same circuit so that the lights can be turned on with the doors closed.
- g. Rheostat Switch - Rheostat switches are employed with some car heaters to control the speed of the motor, and are mounted in some light switches to control the brilliance of the instrument lights. The switch consists of a resistance wire, wound in coil form, and a lever, controlled by the switch knob, in contact with the resistance.

TITLE: Circuit Breakers and Fuses

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COURSE: Automotive Body and Fender

UNIT III: Electricity

Automotive vehicles employ fuses and breakers in the lighting, accessory and horn circuits for the purpose of preventing an excessive current flow which might damage the wiring, instruments or other electrical units. Fuses are designed to burn out when an overload occurs in the circuit it protects. Circuit breakers are not damaged by an overload.

Fuses used in automotive vehicles consist of a glass enclosed strip of alloy metal which has a low melting point. The fuses vary in size and capacity and are rated according to the amount of current they can safely carry. When an excessive amount of current flows through a circuit, the overload heats the fuse, causing the alloy metal strip to melt. This breaks the continuity of the electrical circuit and stops the flow of current.

Some automotive vehicles employ one or more circuit breakers in place of fuses to protect the wiring and electrical units. The circuit breaker is a current limiting relay, designed to reduce the value of the current flowing through a circuit to a safe value when it is in excess of what is intended for the circuit.

TITLE: Bulbs and Wiring
COURSE: Automotive Body and Fender

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UNIT III: Electricity

The function of the lighting system is to provide sufficient light at night at both the front and rear of the vehicle to permit safe driving. The light from the head lights must not only be placed on the road, but must be directed in such a manner that pedestrians and drivers of approaching vehicles are protected from objectionable glare.

Automotive vehicles are equipped with numerous lights to provide an efficient lighting system for both day and night driving conditions. The various lights require the use of different sizes and types of light bulbs to provide the amount of illumination desired. Light bulbs used in the head lights, spot lights, and road lights are described in this section.

In addition to the head lights, automotive vehicles have numerous other lights which provide safer driving and greater convenience for the driver and passengers. The lights have small incandescent light bulbs mounted in bayonet type sockets and are designed to operate on battery voltage. The bulbs are filled with an inert gas and may contain single or double filaments. Depending upon their design, the bulbs may have one or two contacts in the base, and are attached to a contact in the base, while the other end is grounded to the metal base of the bulb. Light bulbs are made in various sizes from one-half candle power, for use in instrument lights, to 50 candle power, for use in head and spot lights.

TITLE: What The Battery Is and Does

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COURSE: Automotive Body and Fender

UNIT III: Electricity

The automotive storage battery is a concentrated source of electrical energy.

Its primary functions are to: supply electrical power to start the car's engine; supply current to operate the ignition circuit, lights and the rest of the electrical system, when the car's engine speed is too slow for the generator to operate, or when electrical demand exceeds the generators capacity.

The major components of the modern storage battery are the elements, the container and electrolyte solution. 1) The element of a battery consists of a group of positive plates and a group of negative plates with separators between them. Each element is capable of producing approximately 2 volts. Thus, a battery with 3 elements can produce 6 volts, while a batter with 6 elements is capable of producing 12 volts. 2) The elements of a battery are assembled into a container, divided into three separate compartments or cells in the case of a 6 volt battery and six cells in a 12 volt battery. 3) For a battery to do its job of storing and delivering electrical energy, it must be filled with an electrolyte solution of proper strength. To activate the plates the battery is also given an electrical charge.

TITLE: The Alternator and How It
Functions

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COURSE: Automotive Body and Fender

UNIT III: Electricity

The electrical load placed on the automobile's electrical system has increased tremendously in recent years due to increased use of electrical accessories, and increased low speed, stop-and-go driving. Building a conventional D.C. generator to provide increased output at lower speeds is impractical because of size limitations.

A new type alternator was developed to fill the need for handling increased electrical loads at idle or low speeds.

The alternator's basic function is exactly the same as the D.C. generator. It converts mechanical energy into electrical current for use in recharging the battery and operating the rest of the electrical system.

TITLE: Generator and Its Uses
COURSE: Automotive Body and Fender

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UNIT III: Electricity

An automotive type generator is a machine that converts mechanical energy supplied by the engine, into electrical energy used for either recharging the battery or for supplying power to the electrical system. Whether the energy required for the electrical system is supplied directly by the generator and battery, depends on the conditions under which the generator operates. When the standard automotive generator is either at rest or is operating at an extremely slow speed such as at engine idle or when in the heavy traffic of city driving, electrical energy for ignition, lights and accessories is supplied by the battery only, not by the generator. When it is operating at medium speeds, energy is supplied to the electrical system by both the generator and the battery. At high speed, as encountered on open highway driving, the generator alone supplies electrical energy to recharge the battery and to power the electrical system.

TITLE: Power Door Locks

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COURSE: Automotive Body and Fender

UNIT III: Electricity

There are two types of power door locks - Vacuum and Electric.

1. A vacuum door lock mechanism is linked to manual door lock at each door. All doors may be locked simultaneously by manual vacuum switch. Front doors may be locked inside the car by door handle or outside car by key. The rear door may be unlocked inside the car by a remote locking control, when manual. When the vacuum switch is in neutral, doors are automatically locked on acceleration when manual vacuum drops below 8" of mercury and engine returns to normal driving or idling vacuum. The Manual switch position determines which side of actuator valve is to be supplied with vacuum through distributor valve from the vacuum reservoir. Some Chrysler Motors Automobile models have additional Deactmotor Valves for automatic door locking. Automatic valves are located under seat.
2. The electric door lock is operated by a push-pull double acting solenoid attached by a connecting rod to door lock actuating lever in each door. A single-pole double throw switch is mounted on each front door. Switches control the lock and unlock relays which actuate solenoids. Doors may be locked electrically by depressing either switch. Lift switches to unlock doors may be locked and unlocked mechanically in the usual manner. Always use the auto-manufactures shop manuals for details for specifications on repairs and maintenance of power door locks.

 TITLE: Electric Window Controls

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COURSE: Automotive Body and Fender

UNIT III: Electricity

Window regulators are individually powered by electric motors in each door. Motors are controlled by individual switches on each door panel and a master switch mounted on the left front door panel. All switches are retained to trim panel usually by spring type retaining slips at top and bottom sides of switches. A 30 ampere circuit breaker mounted under the instrument panel protects wiring harness and a 15 ampere circuit breaker is used to protect the motor. Always read the shop manual for details of each auto manufacture for their specifications relating to repair procedures.

TITLE: Hydraulic Electric Convertible
Top Controls

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COURSE: Automotive Body and Fender

UNIT III: Electricity

This hydraulic-electric control system, used for raising and lowering the convertible top mechanism consists of a reversible type electric motor connected directly to a hydraulic pump which supplies fluid under pressure to two double acting hydraulic cylinders. Motor and pump are accessible either through luggage compartment or by removing the rear seat. The fluid reservoir is an integral part in relationship to the pump and motor assembly. There are many other types of hydraulic electric convertible top controls but all work on the same principle. Always use the auto manufacture shop manuals for details for specifications in repairs and maintenance of convertible top controls.

TITLE: Electric Power Seat Controls

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COURSE: Automotive Body and Fender

UNIT III: Electricity

There are four (4) way and six (6) way power seat operations. This is operated by a single reversible electric motor located under the front seat. The motor drives a gear assembly which transmits power to slave units located in the seat tracks solenoid clutches in gear assembly, when energized by activation of control switches on left side of front seat, which engaged the flexible drive cables with gear assembly to operate the seat horizontally, vertically and to tilt it. Always use the auto manufacture shop manuals for details for specifications on repairs and maintenance of power seat controls.

TITLE: Frame Repair Safety

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COURSE: Automotive Body and Repair

UNIT IV: Frame Work

In repairing automobile frames there are several safety factors required for proper work habits, equipment used and avoiding hazardous conditions.

A. Work Habits

1. Safety of others and self
2. Proper work procedures
3. Proper use of equipment
4. Use safety goggles and devices
5. Short cuts

B. Equipment

1. Damaged Equipment (Faulty)
2. Proper Equipment and Attachments
3. Shop clothes and safety devices
4. Chains that have pressure on them should have a cover in case of link tearing.

C. Hazardous Conditions

1. Remove gas tank
2. Remove gas lines -
3. Remove brake hose
4. Remove mats - trunk, floor and interior trim
5. Clean shop area

INFORMATION SHEET
YL-4-2

TITLE: The Use of Controlled Heat
in Frame Repair

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COURSE: Automotive Body and Repair

UNIT IV: Frame Work

In frame straightening, only a small amount of heat is required to relax buckles and wild cracks. To apply heat, use a large tip. Adjust acetylene torch to a neutral flame, suitable for working without damage to the metal. In using heat to relax buckles, do not "spot heat", but fan the flame out over a large area. Start well out on the buckles and move the torch in a circular motion toward the center. In this way a large area is heated to a cherry red. (CAUTION) Spot heating will result in overheating and damage to the frame.

TITLE: General Description of Frames

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

Frame side members, which are the basic of frame construction, are usually made of U-shaped channel sections or box shaped sections. Crossmembers of the same material reinforce the frame and provide support for the engine, wheels and suspensions. Various brackets and openings are provided to permit installation of the many parts which make up the automotive chassis. The box channel type of construction is composed of two U-shaped channel sections, fitting - is obtained by overlapping the free edges of two U-channel sections and either bolting, riveting or welding them together. The various brackets, crossmembers and braces are welded, riveted, or both, to the frame side rails. Most frames are wide at the rear and narrow at the front. The narrow front construction enables the vehicle to make a shorter turn. A wide frame at the rear provides better support of the body. There are four controlling parts of the frame.

1. Front crossmember
2. Crossmember at cowl
3. Crossmember at rear door
4. Crossmember at gas tank

Where crossmembers do not exist at a controlling point, the controlling points are referred to as dividing areas.

TITLE: Types of Frames

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

- A. Type Frames: Frames vary in size and shape to accomodate the particular units they are intended to receive. Type frames are constructed with a tubular center section. The propeller shaft is enclosed in this tubular center section. The side members or rails are of the box channel type construction. A heavy front cross member is used to support the upper and lower suspension control arms and coil springs. The "kick up" at the rear (that portion of the frame raised above the center section) is to accommodate the rear axle assembly and permit flexing of the rear springs. By using a "kick up" at both front and rear wheels the center of the frame can be kept lower. Extended brackets welded to the frame side members provide for the mounting of the body.
- B. Ladder - Type Frames: A ladder type frame has no center bracing. However, additional cross members provide the necessary bracing for rigidity. The side members are the box channel type construction.
- C. Perimeter - Type Frame: The perimeter type frame is similar in construction to the ladder frame. The side rails support the body at its greatest width which provides more protection to the passengers in case of a side impact to the body. The bend in the frame side rail just behind the front suspension cross member is sometimes referred to as a torque box section.
- D. Bolt on Stick Frame: Some car manufacturer- attach a partial front frame by rubber isolated mounts to a body which is bolted or welded to the body assembly which supports the rear suspension and also similar to the rear end of a conventional frame; however, numerous variations and combinations of the described section of the frame are built into the body.

- E. Unitized Body and Frame Construction: Some manufacturers combine the body and frame into a single unitized section. All of the metal parts which makeup the body shell and supports for the driving, braking and suspension loads are welded into a single unit thus creating an integral body and frame of all steel welded construction. Typical unitized body and frame are composed of the following components. The floor pans and side rails assembly, which include the rocker panels from the underbody area, incorporate attachment provisions for the power plant, power train and suspension systems. The side rails, sometimes referred to as body sills on this type of construction, and various crossmembers are of heavy box type sections which distribute the load over board areas of the body structure. The front suspension member assembly which supports the engine and front suspension is structurally similar to the front end of a conventional frame. The rear suspension member assembly which supports the rear suspension is also similar to the rear end of a conventional frame; however, the assembly, above the side rails the body structure is comparable to that of a vehicle with a separate body and frame construction.

TITLE: Types of Frame Damage
COURSE: Automotive Body and Fender

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UNIT IV: Frame Work

- A. Sway: Side way sway is misalignment of the frame due to the bending sideways of either or both side rails. The sway is caused by a front end side collision or rear end side collision.
- B. Sag: Side rail sag is misalignment of the frame due to the bending downward of either or both side rails. Two different types of sag are caused by front end collision and rear end collision.
- C. Frame Mashed or Buckled: A mashed or buckled frame is more seriously damaged than either a swayed or sagged frame. A mashed or buckled frame results from an extremely severe impact. In addition to side rail sag and buckling on top of the side rail, the frame is bent down and buckled underneath the side rail.
- D. Diamond Frame: A diamond shaped frame comes as the result of a lower impact, sufficient to push the crossmembers out of right angles to the side rails.
- E. Twisted Frame: Upon diagnosis of collision damage, often times a twist condition will show. However, after correcting mash, sidesway and sag conditions, twist usually will remove itself.

TITLE: The Key to Frame Straightening

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

With present day cars, there are more and more collisions resulting in mashed frames. Any passenger car frame straightening job can be done with confidence on the part of the operator if he understands and keeps in mind this basic principle: When making a hook up to restore a passenger car frame to manufacturer's specifications, provide for a stretching pull wherever possible, in conjunction with ordinary push or pull.

For instance, when correcting sags or side sways caused by end blows, use a stretching pull with the usual hookup.

The stretching pull reverses the direction of the impact which caused the damage.

Always remember that the "key to frame straightening" lies in these two principles:

Diagnose: Detailed appraisal of damage to car or truck and determining condition of frame; knowing how many major bends there are and how great each one is.

Preparation: Getting car or truck ready for straightening and complete hook up.

TITLE: Frame Specifications and Datum
Line

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COURSE: Automotive Body and Frame

UNIT IV: Frame Work

Frame Specifications:

Both the conventional frame and unitized underbody assemblies are symmetrical in design. They are assembled and welded in jigs in tolerances of $\pm 1/8$ inch. Manufacturers of automobiles and of frame-straightening equipment provide frame and unitized underbody dimension charts which show exact measurements that can be taken from definite reference points. By comparing the measurements taken from a dimension chart, any misalignment can be determined.

Datum Line:

A datum line is an imaginary horizontal line appearing on frame blueprints or dimension charts to determine correct frame heights. Vertical measurements are given from specific points on the frame to this imaginary line. To check the datum line, attach the datum line gauges with magnetic holders to bottom of siderail at the locations of the vertical measurements indicated on the blueprints. Adjust and level the cross bars to equal the given vertical measurements. Sight datum line points. All pointers must be in line when the datum line is correct.

TITLE: Frame Repair Equipment and
Safety Precautions

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

There are two basic types of equipment used for straightening frames of automobiles. One type is stationary and the vehicle is driven on to the equipment for straightening. The other type is moved to the vehicle. Both methods use hydraulic jacks as power for straightening.

The stationary equipment consists of heavy members to which the vehicle is fastened with chains and clamps. These same members are used as a base for the hydraulic jacks to force the damaged frame members back into their original positions.

In the portable type of equipment, the equipment is attached to the damaged car in such a way that the car frame or chassis members are used as a base against which the force of the hydraulic jacks is exerted.

Safety Precautions

When using chains to anchor the chassis, several safety precautions must be remembered. First of all, do not pull chains around sharp corners as that will result in nicking the chain which in turn will develop a crack and eventually cause the chain to break. Chains should never be heated with a torch as this will destroy any heat treatment and seriously weaken the chain.

It is also poor practice to belt chain links together as the bolt may not be strong enough to withstand the force being exerted. When chains break, the ends will fly with a whiplike action and may cause severe damage or injury. To be on the safe side, it always pays to cover the chains with an old cover material. In that way any snap-back of the chain will be smothered.

TITLE: Frame and Body Estimating

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

The methods used to estimate the cost of body and frame repair would depend largely upon the extent of the damage and the equipment available to make such repairs. In some localities, repairmen charge a flat fee when a car is placed on their rack regardless of the extent of the frame damage.

The lack of frame straightening equipment and the production of more cars with unitized body and frame construction emphasizes the need for the portable type of frame and body equipment. This has changed to a certain extent the method by which the cost of frame work is estimated. The hourly rate system now seems to be used in some frame and body shops. The hourly rate system sets up a certain time in which to make a correction. In some localities when a vehicle is left open, and the cost is determined after the frame is straightened. The ability of the frame repair man to know his equipment and estimate the time needed to do a certain repair is a matter of experience.

TITLE: Frame Checking Equipment

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COURSE: Automotive Body and Fender

UNIT IV: Frame Work

Using Frame Gages:

There are many different types of frame gages available for determining whether a frame is misaligned. Their use will quickly tell whether the frame is twisted, swayed, sagged or diamond-shaped.

The basic set of frame gages consists of four self-centering units with adjustable hangers. These gages can be hung directly on the side rails or in holes in the frame. Such gages are adjustable to frames of different widths and height. The center of the gage is provided with a sighting pin which is always centrally located. A minimum of three gages should be used.

For a diamond-shaped frame, the diagonal dimensions of the frame are measured with a tram gage. All diagonal dimensions are of equal distance to the same matching reference points, unless otherwise specified.

In the absence of specialized tramming equipment an adequate job of alignment can be accomplished with a plumb bob.

Select several points along one frame side rail and very carefully transfer these points to the floor by means of a plumb bob. Locate the corresponding points along the opposite side rail and very carefully transfer these points to the floor in the same manner. Carefully measure the distance between points which are marked on the floor. Corresponding measurements should be the same within 1/16 inch.

Tracking Gage:

Check tracking with a tracking gage. Object of the tracking check is to determine whether car is short on one side or other. Tracking also determines whether the rear wheels follow the front wheels properly. A vehicle that is not tracking properly is said to be "dog tracking". A tracking or tramming gage and three adjustable pointers are used to check wheels tracking.

TITLE: Front Suspension Nomenclature

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UNIT IV: Frame Work

What and Why of Wheel Alignment:

The main purpose of wheel alignment is to make the wheels roll without scuffing, dragging or slipping under all road operating conditions. This gives greater safety in driving, easier steering, longer tire wear and less strain on the parts that make up the front end of the automobile.

Five angles are the foundation of wheel alignment. These angles are designed into the vehicle by the manufacturer to properly locate the weight on moving parts and to facilitate steering.

Specifications provide a range for each angle which serves as a guide for what each angle should be. Good wheel alignment maintains the five simple angles within the range of the manufacturer's specifications.

Caster:

Caster is the backward or forward tilt of the king-pin or spindle support arm at the top. Caster is a directional control angle measured in degrees and is the amount the center line of the spindle support arm is tilted from true vertical.

Backward tilt of the spindle support arms at the top is positive caster. Forward tilt of the spindle support arm at the top from true vertical is negative caster.

Tilting the spindle support arm gives front wheels the tendency to maintain straight ahead position by projecting the center line of the support arm ahead, and establishing a lead point ahead of the point of contact of the wheel.

Camber:

Camber is the inward or outward tilt of the wheel at the top.

Camber is a tire-wearing angle measured in degrees and is the amount the center line of the wheel is tilted from tire vertical.

Outward tilt of the wheel at the top from tire vertical, is positive camber. Inward tilt of the wheel at the top from tire vertical is negative camber.

Where camber conforms within the range of specifications, the weight of the vehicle is positioned on spindle and wheel bearings. Camber will change under weight to varying degrees because of independent front-end construction design. The top of the wheel is allowed to move in and out while the bottom remains stationary.

Steering Axle Inclination:

Steering axis inclination is the inward tilt of the king-pin or spindle support arm at the top.

Steering axis inclination is a directional control angle measured in degrees and is the amount the spindle support center line is tilted from true vertical. This angle is non-adjustable.

Turning radius defined means toe out on turns. The inner front wheel turns shorter than the outer front wheel creating a toe-out condition when the vehicle is turned either to the right or left. The design of the steering arms in relation to the wheelbase of the vehicle provides this proper relationship.

Turning radius is a tire wearing angle measured in degrees and is the amount one front wheel turns sharper than the other on a turn. The manufacturer usually allows a difference of one degree between the inner front wheels, when measured on each turn.

Correct turning radius allows the front tires to roll free on the turns. For that reason, turning radius will be correct when the other alignment angles are correct, except when a steering arm is bent.

Toe-In:

Toe-in is the distance the front of the wheels is closer together than the rear of the front wheels.

Toe-out is the distance the front of the front wheels is farther apart than the rear of the front wheels.

Toe-in is considered the most serious tire wearing angle of the five, and it is measured in inches. Its purpose is to compensate for widened tolerances in the steering linkage. Its tire wear appears as a feathered edge scuff across the face of both tires.

Toe-in is the last of the alignment angles to be set in any wheel alignment operation. It is adjusted by turning the tie rod adjusting sleeves until the measurement taken at the front of the wheels comply to car manufacturer's specifications.

TITLE: Tire and Wheel Balance
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UNIT IV: Frame Work

Carefully balanced, true running wheels are an essential factor, making for easy steering and maximum tire mileage. The importance of maintaining running balance in all wheel and tire assemblies cannot be over estimated.

A tire when mounted on a wheel of a car and driven at anything like out average high way speeds of today becomes only a part of a rapidly turning mass - wheel, brake drum, hub and tire revolve as a unit.

With today's high speed cars, this turning speed may reach 1000 revolutions per minute and even higher.

A terrific centrifugal force is set up, and any unbalanced condition of this revolving mass of rubber and steel creates vibrations that are both destructive and dangerous.

Due to the fact that the two front wheels are directly connected together by the steering system through tie rods and ball joints and also connected to the steering gear, it is of vital importance that front wheel assemblies be maintained in smooth running balance.

Otherwise, the life of all suspension and steering parts, including the steering gear, will be greatly reduced, to say nothing of an unbalance making for a tiresome, unsafe driving condition.

There are two ways in which every wheel can be balanced, statically and dynamically. In both cases, the entire wheel assembly, including the hub and tire, should be taken into account.

Static balance, sometimes called still balance, is the equal distribution of the weight of the wheel and tire around the axis of rotation, or spindle, in such a manner that the wheel assembly has no tendency to rotate by itself regardless of its position. For instance if there is a chunk of mud on one side of the wheel, this side is not in balance with the other side.

If this wheel is lifted clear of the road, it will rotate by itself until the heavy side is at the bottom.

Any wheel that has such a heavy spot in it is statically out of balance. When the wheel is rotated at high speed, centrifugal force acts on the unbalanced weight in such a way that the weight drags the wheel out of its true circle of rotation.

This results in a characteristic "happening" action of the wheel, which decreases steering stability. The greater the unbalanced weight, or the greater the speed, the worse this condition becomes.

Dynamic or running balance means that the wheel must be in static balance, and also must run smoothly at all speeds on the axis which runs through the center line of the wheel, and that the wheel is at right angles to the axis of rotation.

To understand the principle of dynamic balance, let's start by fastening a weight to string and swinging it slowly. The string will make a small angle with the axis of rotation.

Any revolving weight shows this same tendency. The weight will always try to move so that its path rotation is at right angles to the axis of rotation.

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TITLE: Steering Gear

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UNIT IV: Frame Work

In most cars and trucks, the steering gear is bolted to the frame of the vehicle. The steering column at an angle through the fire wall-(cowl) or floor pan and into the driver's compartment where the steering wheel is attached. A pitman arm (which swings back and forth as the steering wheel is turned) is attached to the lower end of the steering gear and to the steering knuckle arm at each front wheel by means of linkages. As the steering wheel is turned the pitman arm and its connecting linkages cause the front wheels to swing back and forth for steering purposes.

Steering Gear Construction:

All steering gears are enclosed in a supported housing unit. The steering gear consists of a worm gear of some type which is contained within the housing. This worm like device is at the bottom of the steering column. The steering column or shaft and worm gear can, for all practical purposes, be considered as one piece. Ball bearings or roller bearings support the worm in the steering gear housing. An adjustment in the form of shims located between the housing and plate and housing or a threaded bearing adjuster nut permits the maintaining of the correct bearing preload on the worm. The steering wheel is mounted on the upper end of the column by splines and a nut. The steering column assembly is enclosed within a jacket, consisting of a hollow tube encircling the column assembly.

The cross shaft is located in the housing, usually at right angles to the steering column and is supported on bushings. The steering gear cross shaft incorporates a sector gear, a roller, or a liner, which meshes with the worm on the column. The outer end of the cross shaft extends through the housing, at which location the Pitman arm is attached by means of splines and hold in place by a nut. The adjusting screw permits adjustment of steering gear lash or end play of the cross shaft.

Types of Steering Gear:

Steering gears are classified according to the device used for coupling the cross shaft to the column. The types of steering gears in general use are of the worm and roller, the cam and liner, or the recirculating ball type.

TITLE: Purpose of Brakes

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COURSE: Automotive Body and Fender

UNIT V: Hydraulics

The purpose of the brakes on an automotive vehicle is to stop the vehicle, or to slow down its rate of travel, as required at any time during the operation of the vehicle. Whenever an automotive vehicle is in motion the safety of the operator, passengers, pedestrians, other vehicles, and public property depends upon the condition of the brakes with which that vehicle is equipped. The brakes on such a vehicle must be capable of stopping the vehicle quickly, reliably, at all times and under varying conditions, to avoid collisions and to permit the operator to retain control of the vehicle.

Automotive vehicles are usually provided with two braking systems to conform to existing regulations. One is the service brakes, which operate on all four wheels and are applied through hydraulic pressure created by the operator applying foot pressure on the brake pedal. The second system is the hand or parking brakes which may operate the service brake shoes on the rear wheels only, through a hand lever and cable arrangement, or may, through the same linkage, operate a brake band contracting around a drum on the transmission shaft. In some vehicles this parking brake lever is arranged to be operated by foot pressure also.

TITLE: How Brakes Stop the Vehicle

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UNIT V: Hydraulics

The stopping distances are based on favorable road conditions and reaction time. Stopping distances will vary, depending on the type and condition of the road surface, the mechanical condition of the vehicle, and the variation of individual driver's reaction time.

Brakes are designed to stop a vehicle within the indicated distances while on average road surfaces.

Poor road conditions or an overloaded vehicle will also increase the stopping distance. Worn linings or drums, glazed linings, or grease-soaked linings lower the coefficient of friction, also contributing to increased stopping distance.

Poorly adjusted brake shoes prevent the full application of braking effort due to lack of full contact between shoe and drum. Lack of leverage, due to improper adjustment or wear, also prevents the full application of braking force.

TITLE: Construction of Brakes

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COURSE: Automotive Body and Fender

UNIT V: Hydraulics

Both front and rear wheel brakes used on passenger automobiles are of the internal expanding, hydraulically operated type. Hydraulic pressure operates pistons inside wheel cylinders to force the brake shoes into contact with the brake drum, when the brakes are applied.

Certain parts are common to all passenger vehicle wheel brake assemblies. Included among these are a backing plate, brake shoe anchors, brake shoes, retracting springs, brake linings, brake drum, wheel cylinder or cylinders and adjusting mechanisms.

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TITLE: Brake Lines

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UNIT V: Hydraulics

Steel tubing which resists corrosion while withstanding high pressure is used between the master cylinder and frame connections, and between the rear flexible hose and rear wheel cylinders. Flexible hoses connect the tubing to the front wheel cylinders.

In replacing brake tubing, always use metal tubing which is designed to resist corrosion and withstand the high pressures encountered within the hydraulic system. The tubing must be double flared at the connections so as to produce a strong leak-proof joint. Low pressure copper tubing must not be used.

TITLE: Power Brake Systems

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UNIT V: Hydraulics

Many of the present day passenger cars are being manufactured with power brakes as standard or optional equipment. All passenger cars equipped with power brakes use intake manifold vacuum and atmospheric pressure to increase the pressure in the hydraulic system. The reason for using power brakes on passenger cars is to reduce the brake pedal movement and foot pedal pressure required to stop the vehicle. In the event of a power unit failure it is possible to stop the vehicle by applying extra heavy pressure on the brake pedal. The power brakes are self-contained hydraulic, vacuum power devices consisting of three basic elements combined into a single unit.

1. A vacuum power cylinder.
2. A hydraulic master cylinder with self-contained fluid reservoir.
3. A mechanically actuated control valve.

This unit replaces the ordinary brake master cylinder and are rigidly mounted to the toe board inside the car or to the firewall of the engine side. They are operated by the brake pedal which connects to the control valve push rod. Two other connections are necessary; one to connect the power brake unit with the intake manifold through which vacuum is obtained; the other connection from the master cylinder section to the hydraulic brake system.

Air for proper operation is supplied through an air cleaner attached to the power brake unit. Should failure occur in the vacuum system; several brake applications can be made providing the vacuum check valve is working properly and a vacuum reserve tank is included in the system. Otherwise, extra heavy pressure must be applied on the brake pedal in order to stop the vehicle. There are several different types of power brake units and are listed below.

1. Bendix Treadle-Vac Unit
2. Vacuum Hydraulic Power Brake Unit
3. Bendix Hydrovac Power Brake Unit
4. Bellows-Type Power Brake Unit
5. Bendix Master-Vac Power Brake

TITLE: Air Suspension

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UNIT V: Hydraulics

With air suspension (pneumatic cushioning) the spring forces are resisted by a chamber filled with compressed air, which is formed either by a cylinder containing a piston which can move inside it or which may, alternatively, be designed as a compressible spring bellow! With this arrangement a suitable yielding suspension, well adjusted to the load can be obtained, and the movement of the body (car) thereby reduced (more particularly when traveling in bends) as a result, riding comfort and safety are substantially increased. Depending on the type of suspension concerned, the air forming the cushion has a pressure of 3 to 9 ATM. The piston is connected directly to the sprung masses, which try to push the piston or others into the cylinder. This causes the air in the latter to become more highly compressed and thus resist this movement. The metal bellows which can absorb movements only in the direction of its longitudinal axis is used mainly in conjunction with rigid axles. With this kind of suspension it is necessary to provide special guiding devices in order to obviate the occurrence of transverse forces.

Each bellow is connected to an auxiliary air vessel which ensures that there is always a sufficient quantity of air in the bellows. In the case of the roll bellow a piston shaped movable body is directly connected to the auxiliary air vessel by the bellow. It can also absorb transverse forces and can therefore be used in combination with independent wheel suspension and swinging half axles. The road clearance is automatically always kept constant by means of air equalizing valve (height regulator). The latter is connected to the axle through a linkage system. When the load on the axle increases, the linkage rods will cause the piston of the height regulator to rise so that air from the compressor and storage vessel can flow into the bellows until the car body has risen so high that the inflowing air is cut off again by the piston in the height regulator. When the load on the axle decreases or when the body lifts the piston in the height regulator opens a hole through which air from the bellows can escape into the atmosphere, until the car body has regained its normal position and the piston in the regulator has returned to its middle position. The height regulator can be provided with a damping device which produces a certain time lag in the response of the regulator. The regulating system will then not respond about its normal position, i.e., continual alternation between admission of air into the pneumatic spring and escape of air.

TITLE: Concealed Head Lamps

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COURSE: Automotive Body and Fender

UNIT V: Hydraulics

Auto concealed head lamps are operative two different ways, either by vacuum or by electric. The basic function of each works on the same method of either the head lamp covers opening and closing or the head lamp housing pivots 90° to 180° and the other side of head lamp housing assembly makes up part of grille assembly or body section. The concealed head lamps operate when the headlight switch is turned on or pulled out. When the headlight switch is off the lights are concealed.

The vacuum system (type) consists of two head lamp doors, two actuators, a vacuum storage tank and hoses. This system operates off the vacuum of the engine and can require much correction from time to time (adjustments). All cars using a vacuum system have a vacuum tank that acts as a booster and lights can be operative without the engine running.

The electric system (type) contains many of the same components used by the vacuum system except the electric system uses a closing and opening relay which operates the left motor and the right motor and is controlled by an override switch.

This override switch is built in as a safety device to open lights or close lights if other switches do not work. Each light has a motor operating it.

Either the vacuum or electric systems or both are used on most cars. Always use a shop manual to secure information needed for repairs.

TITLE: Concealed Head Lamps
(Trouble Shooting)

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COURSE: Automotive Body and Fender

UNIT V: Hydraulics

TROUBLE DIAGNOSIS
SHOOTING

Vacuum Type

ALL HEADLIGHTS DO NOT LIGHT.

1. Loose battery cable.
2. Loose quick disconnect or broken wire from battery to headlight switch.
3. Defective headlight switch.
4. Disconnected or broken wire from headlight switch to beam selector switch.
5. Loose or broken wire to bulbs.
6. Defective beam selector switch.
7. All headlight bulbs burned out. This may be caused by a defective or improperly adjusted alternator voltage regulator.

INDIVIDUAL LIGHTS DO NOT LIGHT.

1. Burned out bulb.
2. Loose or broken wires to bulb.
3. Poor ground.

LIGHTS BURN OUT REPEATEDLY

1. Loose or corroded electrical connections.
2. Excessive vibration.
3. Improperly adjusted or defective alternator voltage regulator.

HEADLIGHT COVERS INOPERATIVE

1. Defective wiring from headlight switch to control valve.
2. Defective control valve.
3. Defective hoses.

BOTH HEADLAMPS FAIL TO RAISE

1. Faulty switch.
2. Loose connection at switch or motor.
3. Open circuit between switch and motor.

Electric Type

HEADLIGHTS ON, WARNING LIGHT ON,
HEADLIGHTS WON'T OPEN

1. Faulty circuit breaker located on left side cowl.
2. Faulty opening relay.
3. Incomplete motor ground.

HEADLIGHTS ON, WARNING LIGHT OFF,
HEADLIGHTS WON'T OPEN

1. Incomplete ground to limit switches.
2. Faulty limit switch.
3. Faulty circuit breaker located on left side cowl.
4. Faulty opening relay.

ONLY ONE HEADLIGHT OPENS, RED WARNING
LIGHT ON, HEADLIGHTS ON

1. Faulty motor.

WARNING LIGHT STAYS ON WHEN HEAD-
LIGHTS ARE FULLY OPEN

1. Misalignment of adjusting screw with limit switch.

HEADLIGHTS WILL NOT CLOSE

1. Override switch in override position.
2. Faulty override switch.
3. Faulty control relay.
4. Faulty closing relay.
5. Faulty circuit breaker located on left side cowl.

NOTE: For additional information,
check manufacturer's shop
manual for specific make and
model.

TITLE: Air Conditioning

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COURSE: Automotive Body and Fender

UNIT VI: Air Conditioning

Usually when you hear the term "air conditioning", the first thing that comes to your mind is cold fresh air. Actually, a true air-conditioning system automatically controls the temperature, humidity, purity and circulation of air. In automotive language, air conditioning is any system that cools and dehumidifies the air inside of the passenger compartment of the automobile or truck.

Automotive air conditioners are rated at well over a ton of refrigeration. Because of the tremendous head load on the car, a unit of 8,000 to 10,000 BTU's would do a very poor job of keeping the average car of today cool.

General Motors, for instance, rates their factory installed units at a full one and three-fourths tons, or about 21,000 BTU's. This is the amount of cooling that would be required to cool the average two-bedroom home. Of course, a house is well insulated and the problem of heat by radiation is not so great.

In a mechanical refrigeration system, such as found in the modern automobile, a special refrigerant absorbs heat inside of the evaporator by changing from a liquid to a vapor. The evaporator is that part of the refrigeration system that is located inside the passenger compartment. Thus, air blown over the fins of the evaporator is directed to the passengers inside of the car for their comfort.

We say that the refrigerant absorbs heat inside the evaporator; we must then dispose of this heat. We could just expel the heat-laden refrigerant vapor to the outside air, but this would be much too expensive. The refrigerant is reclaimed for reuse in the system and just the heat is removed and expelled to the outside air.

Reclaiming the refrigerant begins at the compressor. The compressor pressurizes the heat-laden vapor until its pressure and heat reach a point that is much hotter than the outside air. The compressor also pumps the vapor to the condenser, where it gives up its heat and changes once again to a liquid. The condenser is that part of the unit that is located outside the passenger compartment. Since the air passing over the condenser is much cooler than the vapor inside, the vapor gives up much of its heat and changes state to a liquid.

The refrigerant, now liquid, then passes to the receiver drier where it is stored until needed again by the evaporator.

TITLE: Air Conditioning Refrigerants

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COURSE: Automotive Body and Fender

UNIT VI: Air Conditioning

The term "refrigerant" refers to the fluid used in a refrigerating system to produce "cold" by removing heat. Refrigerant 12 has been adopted for automobile use because it has the highest safety factor of any refrigerant available that is capable of withstanding high pressures and temperatures without deteriorating or decomposing.

Since nature did not provide a perfect refrigerant, it was necessary for man to devise a compound to meet his particular needs. A fluorinated hydrocarbon known as carbon tetrachloride meets this requirement most closely with few minor changes.

To improve this element to produce a more desirable refrigerant, two of the chlorine atoms are removed and two atoms of fluorine (f) are introduced in their place.

This new compound is Refrigerant 12. It is used in automobile air conditioners and in many other applications. This refrigerant is ideal because of its stability at high as well as low operating temperatures. It does not react with most metals such as iron, aluminum, copper and steel, is soluble in oil and does not harm or is not harmed by rubber. It is nonflammable and nonexplosive in either a gaseous or liquid state and is noninjurious to animal or plant life and has no effect on the taste, smell, or color of water or food.

TITLE: Air Conditioning Refrigerants
Safety Precautions

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COURSE: Automotive Body and Fender

UNIT VI: Air Conditioning

Refrigerant 12 (R12) is odorless and cannot be detected in small quantities. It is colorless and will not stain.

There are, however, a few words of caution concerning the handling of Refrigerant 12 (R12). Suitable eye protection should be worn when handling R12 because of its low evaporating temperature. R12 evaporates at -21.6°F .

If liquid R12 strikes the eye, the eyeball may be frozen, thus causing blindness. In the event liquid R12 strikes the eye, do not rub it.

If liquid R12 strikes the skin, frostbite may occur. Care must always be exercised when handling refrigerants. Should liquid R12 strike you anywhere else on the body, apply cool water to raise the temperature and apply clean petroleum jelly.

If R12 is allowed to come into contact with an open flame or a very hot metal, Phosgene gas will be formed. Phosgene gas is poisonous and can be very dangerous. This gas can make a person very sick when inhaled. Phosgene gas inhaled a little at a time over a period of time can be cumulative and may result in a toxic condition.

TITLE: Troubleshooting Checklist

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COURSE: Automotive Body and Fender

UNIT VI: Air Conditioning

System Produces No Cooling:

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
<u>Electrical</u>		
1. Blown fuse.	1. Electrical components will not operate.	1. Replace fuse.
2. Broken or disconnected electrical wire.	2. Electrical components will not operate.	2. Check all terminals for loose connections
3. Broken or disconnected ground wire.	3. Electrical components will not operate.	3. Check ground wire to see if loose, broken, or disconnected.
4. Clutch coil or solenoid burned out or disconnected.	4. Compressor clutch or solenoid inoperative.	4. Check current flow to clutch or solenoid -- replace if inoperative.
5. Electric switch contacts in thermostat burned excessively, or sensing element defective.	5. Compressor clutch inoperative (applies to units having thermostatically controlled recycling.	5. Replace thermostat.
6. Blower motor disconnected or burned out.	6. Blower motor inoperative.	6. Check current flow to blower motor -- repair or replace if inoperative.
<u>Mechanical</u>		
1. Loose or broken drive belt.	1. Visual inspection.	1. Replace drive belts and/or tighten to specifications.
2. Compressor partially or completely frozen.	2. Compressor pulley slips on belt or will not turn when clutch is engaged.	2. Remove compressor for service or replacement.
3. Compressor reed valves inoperative.	3. Only slight variation of both gage readings at any engine speed.	3. Service or replace compressor reed valves.
4. Expansion valve stuck in open position.	4. Head pressure normal, suction pressure high, evaporator flooding.	4. Replace expansion valve.
<u>Refrigeration</u>		
1. Broken refrigerant line.	1. Complete loss of refrigerant.	1. Examine all lines for evidence of breakage by external stress or rubbing wear.

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<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
2. Fusible plug blown (does not apply to all units.)	2. Complete refrigerant loss.	2. Examine fusible plug- if blown, replace with correct plug.
3. Leak in system.	3. No pressure on high and low gages (applies to any system having complete loss of refrigerant.	3. Evacuate system, apply static charge, leak test system, and repair leak as necessary. Replace compressor shaft seal.
4. Compressor shaft seal leaking.	4. Clutch and front of compressor oily; system low or out of refrigerant.	4. Replace compressor shaft seal.
5. Clogged screen or screens in receiver dehydrator or expansion valve; plugged hose or coil.	5. High gage normal or may read high. Low gage usually shows vacuum or very low pressure reading. Frosting usually occurs at point of blockage.	5. Repair as necessary.

System Will Not Produce Sufficient Cooling:

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
<u>Electrical</u>		
1. Blower motor sluggish in operation.	1. Small displacement of air from discharge duct; blower motor possible noisy.	1. Remove blower motor for service or replacement.
<u>Mechanical</u>		
1. Compressor clutch slipping.	1. Visual inspection.	1. Remove clutch assembly for service or replacement.
2. Obstructed blower discharge passage.	2. Blower operates at high speed but air displacement very small.	2. Examine entire discharge passage for kinks, waddings, or failure to open passage during installation. Correct as necessary.
3. Clogged air intake filter.	3. Insufficient air displacement by blower.	3. Remove air filter screens and service or replace, whichever is necessary.

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CAUSE	INDICATIONS	REMEDY
4. Outside air vents open.	4. Insufficient cooling at highway speeds.	4. Close air vents (adjust controls if necessary). NOTE: Some owners must be instructed on importance of keeping air vents closed when air-conditioning unit is in operation.
5. Insufficient air circulation over condenser coils; fins clogged with dirt or bugs.	5. Insufficient cooling at discharge outlet; excessive high pressure gage reading; engine temperature usually excessive.	5. Clean engine radiator and condenser. Install heavy duty fan, fan shroud, or reposition radiator and condenser, whichever is necessary.
6. Evaporator clogged.	6. Fins clogged with lint, dust, or coated with cigarette tars.	6. Loosen, pull down, and clean with compressed air. Use cleaning solvent to remove cigarette tars. CAUTION: Protect floor mats.
7. Evaporator pressure regulator, hot gas bypass valve, suction throttling valve, or selectrol defective or improperly adjusted.	7. High pressure gage readings normal; low gage usually reads to high.	7. Repair or adjust as necessary.

Refrigeration

1. Insufficient refrigerant in system.	1. Bubbles in sight glass; high gage readings excessively low.	1. Recharge system until bubbles disappear and gage readings stabilize to specifications.
2. Clogged screen in expansion valve.	2. Gage pressures may be normal or may show slightly increased head pressure and low suction pressure; discharge output temperature higher than specified.	2. Purge system, remove screen, clean and replace.
3. Expansion valve thermal bulb has lost charge.	3. Excessively high or low gage readings; may cool in excess or not enough.	3. Purge system; replace expansion valve.

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
4. Clogged screen in receiver.	4. High pressure gage usually higher than normal; low pressure gage lower than normal; receiver cold to touch and may frost.	4. Purge system; replace receiver.
5. Excessive moisture in system.	5. Excessive head pressure gage reading.	5. Purge system; replace dehydrator.
6. Air in system.	6. Excessive head pressure, sight glass shows bubbles or is cloudy.	6. Purge, evacuate, and charge system.
7. Thermostat defective or improperly adjusted.	7. Low gage reading high; clutch cycles at too high a reading.	7. Adjust or replace thermostat.
NOTE: When a unit must be removed from the system for service or replacement, the system must have the dehydrator replaced also, and the system must be purged, evacuated, and recharged to remove excess moisture.		

System Cools Intermittently:

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
<u>Electrical</u>		
1. Defective circuit breaker, blower switch or blower motor.	1. Electrical units operate intermittently.	1. Remove defective part for service or replacement.
2. Partial open, improper ground, or loose connection in compressor clutch coil or solenoid.	2. Clutch disengages prematurely during operation.	2. Check connections or remove clutch coil or solenoid for service or replacement.
<u>Mechanical</u>		
1. Compressor clutch slipping.	1. Visual inspection; operates until head pressure builds up (as viewed on high pressure gage) at which time clutch begins slipping; may or may not be noisy.	1. Slippage over a prolonged period will require that clutch be removed for service; may require readjustment for proper spacing

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
<u>Refrigeration</u>		
1. Unit icing up may be caused by excessive moisture in system, incorrect super heat adjustment in expansion valve, or thermostats adjusted too low.	1. Unit ices up intermittently. NOTE: Any unit will ice up under certain ideal operating conditions of refrigerant temperature, humidity, and ambient temperature.	1. Replace expansion valve; replace dehydrator if excess moisture present; adjust thermostat.
2. Thermostat defective.	2. Low side pressure may be low or excessively high; adjustments will not correct.	2. Replace thermostat.
3. Stuck hot gas bypass valve or suction throttle valve.	3. Both head and suction pressures low; moisture in system usually indicated.	3. Purge and evacuate and replace dehydrator to remove moisture; if still stuck, replace hot gas bypass valve.

Excessively Noisy System:

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
<u>Electrical</u>		
1. Defective winding or improper connection in compressor clutch or solenoid.	1. Visual inspection; solenoid or clutch vibrates.	1. Replace or repair as necessary.
<u>Mechanical</u>		
1. Loose or excessively worn drive belts.	1. Belts slip and are noisy.	1. Tighten or replace as required.
2. Noisy clutch.	2. May or may not slip; noisy when engaged.	2. Remove clutch for service or replacement as necessary.
3. Compressor noisy.	3. Loose mountings; worn parts inside compressor	3. Check mountings and repair; remove compressor for service or replacement.
4. Loose panels on car.	4. Excessive rattles during operation.	4. Check and tighten all panels, hose hold-down clamps, or rubbing or vibration of hoses or pipes.

<u>CAUSE</u>	<u>INDICATIONS</u>	<u>REMEDY</u>
5. Compressor oil level low.	5. Compressor noisy and lower portion hot to touch.	5. Fill with correct specified oil.
6. Blower fan noisy; excessive wear in blower.	6. Blower motor noisy.	6. Remove blower motor for service or replacement as necessary.
7. Idler pulley and bearing defective.	7. Whining or growling noise during operation; pulley has rough feel when rotated by hand.	7. Replace bearing; inspect idler and pulley as may be worn excessively.

Refrigeration

1. Excessive charge in system.	1. Rumbling noise or vibration in high pressure line; thumping noise in compressor; excessive head pressure and suction pressure; bubbles in sight glass.	1. Discharge excess freon until high pressure gage drops within specifications.
2. Low charge in system.	2. Hissing in evaporator case at expansion valve; bubbles or cloudiness in sight glass; low head pressure.	2. Check system for leaks; charge system.
3. Excessive moisture in system.	3. Expansion valve noisy; suction pressure low.	3. Replace dehydrator; purge, evacuate, and charge system.
4. High pressure service valve closed.	4. Compressor has excessive knocking noise; high pressure gage reads above normal.	4. Open valve immediately.

ABNORMAL PRESSURE GAGE READINGS

I. Low Suction and Pressure Normal

- A. Thermometer defective.
- B. Screen in expansion valve clogged.
- C. Restriction between receiver and expansion valve.
- D. Moisture in system.
- E. Expansion valve closed if low pressure gage reads a vacuum.

II. High Suction Pressure, Head Pressure Normal

- A. Improper operation of expansion valve.
- B. Sensing element of expansion valve defective or making improper contact.

III. High Suction Pressure, Low Head Pressure

- A. Compressor defective.
- B. Compressor reed valve defective.

IV. Excessive Head Pressure

- A. Air in system or excessive charge of refrigerant in system.
- B. Condenser air passages clogged.
- C. Restriction in condenser, dehydrator, filter, or any high pressure line.
- D. Excessive oil in compressor.
- E. Engine overheating.

TITLE: Cooling System Components and
Types of Radiators

Page 1 of 1 page

COURSE: Automotive Body and Fender

UNIT VII: Radiator Repair

Cooling systems are made up of many individual components. These components operate in close association with each other enabling the engine to maintain a proficient operation temperature and thus efficient power. Reduced performance or failure of any one of these components will require servicing or repairing to restore engine performance to normal requirements.

Radiators can be classified according to the type of coolant passages used in the core design. There are two common types, the tubular and the cellular. The tubular is the most popular. This type can operate under higher pressures with the same weight considerations. Radiators can also be classified with respect to the direction of coolant flow through the radiator. The direction may be either vertical or horizontal. The vertical flow is known as the downflow and the horizontal as the crossflow. Headers are also classified. These types include flat top, bucket and bolt-on.

Tubular: This type is constructed of tubes which are soldered at each end to the headers. The tubes may be arranged in either the downflow or the crossflow configuration. Thin sheets or fins are located between the tube rows and are bonded to the tubes. This bonding provides for maximum heat transfer from the coolant to the surrounding air via the tubes to the fins.

Cellular: This type is an assembly of corrugated and crimped thin metal sheets that are soldered together. The headers or core-to-tank seams are an integral part of the core. They are formed by overlapping or interlocking the thin water passages to provide a structure for attaching the tank. There are two types of cellular cores. They are the single row fin type and the double row fin type.

Solder-on Tanks: These tanks are fitted to a raised lip around the edge of the header. The rim of the tank is attached by fitting the tank rim either inside or outside the raised header lip. To remove a tank from this type header requires removal of all solder from the lip channel.

TITLE: Tools Required
COURSE: Automotive Body and Fender

Appendix A
Page 1 of 3 pages

The following list of tools for this course is intended to be used only as a guide for preparing final tool requisition:

Hammer, metal --- double faced dinging, picking - three length - curved and straight, finishing, roughing, offset cross and straight-peen, soft face, trim

Hammer, machinist, three sizes

Hammer, blacksmith, three sizes

Hammer, sledge, two sizes

Mallet, rubber, two sizes

Mallet, wood

File, body, straight, half-round, curved

File, body, reveal set with holder, 6 pieces

File, variety of machinist

Pliers, assortment

Screw driver, standard, phillips, clutch

Punch set

Chisel set

Snips, combination

Snips, aviation, set, right and left hand

Shears, floor

Wrench sets, box, open end, fractional, metric

Wrench, adjustable, 6", 8", 10"

Wrench, pipe, variety of sizes

Wrench, rim

Vise-grip welding clamps

Vise-grip bending tool

Vise-grip wrench

Socket sets, 3/8", 1/4", 1/2" drive, shallow and deep socket

Cutters, bolt, with 24" handle

Clamps, "C" variety - 4", 6", 8"

Drills, twist, fractional, number and some letter

Scraper, carbon

Knives, putty

Hacksaw frames

Saw, saber

Saw, hole, 3/4" to 3" diameter

Tapes, steel, 10', 25'

Tap and dies, standard - N.C. and N.F., machine screw set

Rethreading die sets - N.C. and N.F., nut type

Carbon brush set, fits 1/4" drill

Cutters, panel

Door handle tools, G.M., Ford and Chrysler

Door panel remover

Pull rod set, metal repair tools

Pick set, forged body

Bars, pry

Bars, bending

Insert tool, head lining

Rules, steel, 12", 24", 36"

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Flaring tool

Spoons, pry, bumping, offset, general, roughservice, comgination

Gage, self center

Gage, tram, adjustable, several sizes

Hammer, slide, light work

Hammer, slide, heavy duty

Dollies, many different types

Plates, tension, solder and clamp

Light cords

Trimmer, disc sanding

Solder paddles

Brush, wire 12", paint - assorted sizes

Brush striping, lettering, flux

Creeper, low profile

Pans, drain, 3-gallon capacity

Covers, fender, with rubber backs

Clamps, body

Cords, extension, electrical

Cords, extension, electric light

TITLE: Suggested List of Equipment

Appendix B

COURSE: Automotive Body and Fender

Page 1 of 2 pages

The following list of equipment for this course is intended to be used only as a guide for preparing final equipment requisition:

Air compressor, 10 h.p.

Welding and cutting units, gas and portable

Welder, arc -- 250 amp capacity

Welder, spot

Drill press, 1/2", chuck capacity

Grinder, 6" wheel, bench or pedestal

Saw, saber

Snear, metal cutting bench model

Cutter, panel, pneumatic

Soldering iron, 200 watt, 250 watt

Head light aiming machine

Drills, portable, electric 1/4", 3/8", 1/2" capacity

Sanders, body 9" disk, electric

Polishing machine, 7"

Sanders, block type, electric or air

Jacks, body, complete with pump, ram and attachments 10-ton capacity

Jacks, body complete with pump, ram and attachments 2-ton pull, 4-ton push

Jack, frame, 10-ton capacity

Jacks, floor, hydraulic, 2-ton capacity

Jack, bumper, hydraulic, 2-ton capacity

Stands, floor, automotive

Rick racks, for holding body panels 24" x 48"

Benches, metal tops 30" x 72"

Air pressure regulators, with moisture traps, 0 to 100 lb. gage

Hoses, air, 1/4" and 3/8" I.D., 50' length

Tape apron

Vises, 4" jaws, swival base

Vise, glass

Extinguishers, fire

Light, drying, complete set with 8 heating elements

Hose, water, 5/8" I.D., 25' long

Guns, spray, siphon cup type

Frame machine, pit or portable

Hydraulic, double or single post lift